WORLD PETROLEUM

NOVEMBER, 1960

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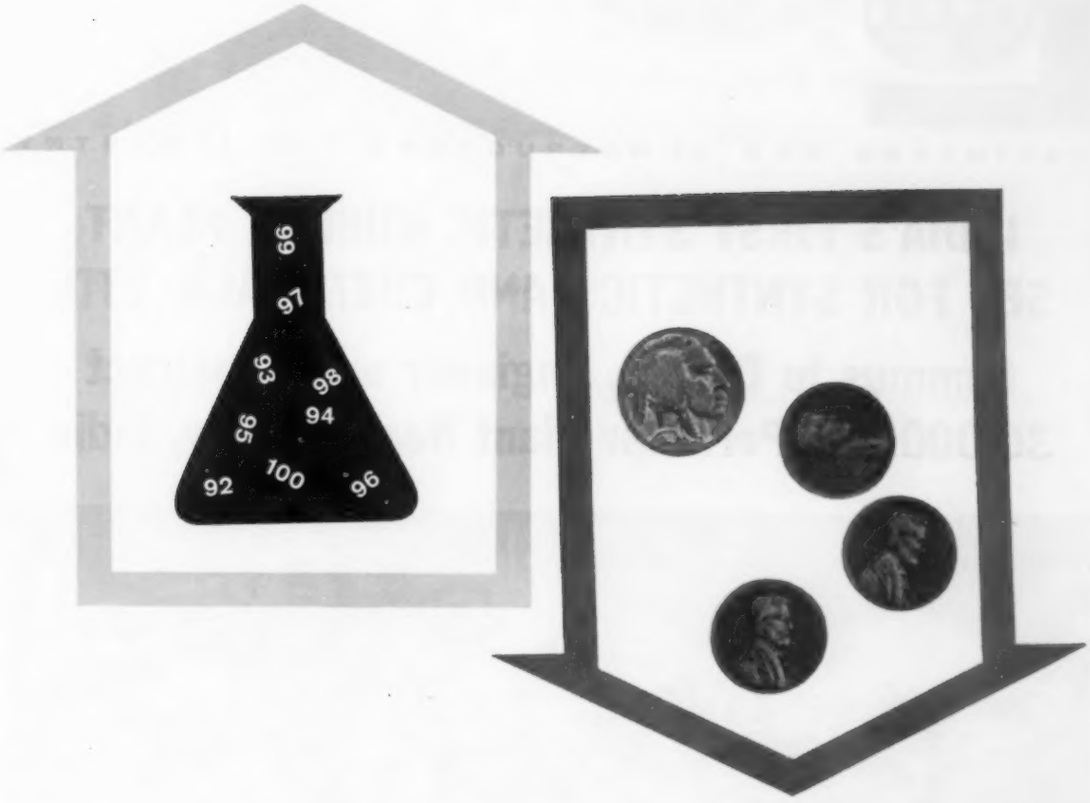

Octane numbers at lower cost—from Ethyl's refinery technology service

Helping refiners attain octane numbers—at lowest possible cost—is the basic and continuing objective of Ethyl's expanding refinery technology program.

Studies for individual refiners, to determine optimum blending of the various available components, have been broadened and expanded through the use of linear programming and high speed computers.

More general studies, for the entire industry, are carried on in a number of areas. For example, Ethyl studies have determined blending effectiveness and road performance of gasoline components from improved refining processes. A comprehensive study of premium gasoline antiknock behavior has confirmed the validity of Ethyl's method for predicting road octane numbers from laboratory data. And, it produced new equation coefficients for calculating road octane numbers.

Still another study has developed equations that are accurate for calculating both Research and Motor octane of multi-component blends—greatly extending the scope of "paper studies" of refinery gasoline pools.

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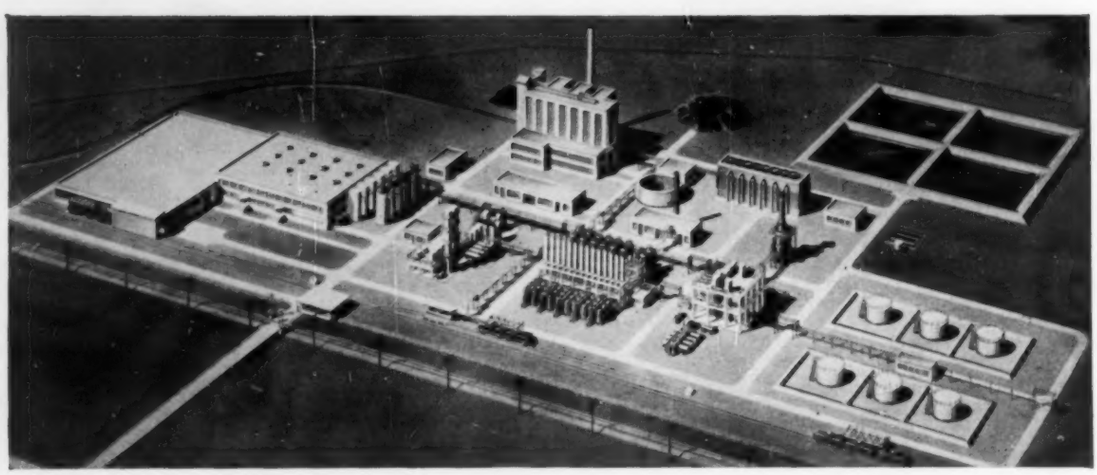
Lummus to Design, Engineer and Construct 30,000 Ton Per Year Plant Near Bareilly, India



The Lummus Company has been awarded the contract to design, engineer and construct a 30,000 ton per year synthetic rubber plant near Bareilly, Uttar Pradesh, India for Synthetics and Chemicals, Ltd. This firm was recently formed by The Firestone Tire & Rubber Company in association with the banking and industrial firm of Kilachand Devchand and Company Private, Ltd. of Bombay.

The 30 million dollar project will include plants for the production of butadiene and styrene, the principal raw materials, as well as a copolymer plant to manufacture the final product, synthetic rubber. In addition, Lummus will construct all the plant utilities and offsites. Although Lummus will design the plant for a capacity of 30,000 tons or more per year, the initial annual production will be 20,000 tons. Technical divisions of The Firestone Tire & Rubber Company are furnishing the basic engineering and know-how for the butadiene, styrene and copolymer units.

The plant site has been established in the heart of the sugar cane and alcohol producing area, and the alcohol obtained from the sugar cane will be the source of the butadiene, the principal ingredient of synthetic rubber.

Indian technicians and operating personnel will be trained to run the plant, whose final products will meet standard world-wide industry specifications.

Financing of the project will be assisted by a 27,100,000 Indian rupee (or $5,700,000) loan from the Export-Import Bank of Washington to Synthetics and Chemicals, Ltd. This constitutes the largest foreign currency loan in the bank's history. The remainder of the financing will come from private banks in the United States and the United Kingdom as well as from India.

The project is expected to save India approximately 10 million dollars in foreign exchange annually.

Lummus has over 50 years' experience in the design and construction of more than 850 plants for the process industries throughout the world. Call Lummus on your next project.

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CONTENTS

4 Washington Pipeline, *by Joseph B. Huttlinger*

8 London Letter, *by Cecil W. Wood*

14 Canadian Notes

22 Latin American Oil News

41 Editorial—Marketing is the Key, *by M. J. Rathbone*

42 Russian Oil—Through American Eyes

47 Communications in the API

48 World Oil Conservation—the Arab View, *by Abdullah Hamud Al-Tariki*

50 Frisia Enters Manufacturing with New 30,000 B/D Refinery at Emden

53 Automated Hydraulic Rig for Faster Deep Drilling, *by Hew D. Fanshawe*

56 DuPont Opens 50 Million Lb/Yr Neoprene Facility in Ireland

60 Petrochemical Acrolein by the Partial Oxidation of Propylene, *by Peter W. Sherwood*

66 Moving a Rig to an Arctic Well

70 Khursaniyah is the Sixth Producing Field for Aramco

74 Italian Developments in Petrochemical Acetylene

80 Automatic Custody Transfer (ACT)—Why and How it Pays Off, *by K. H. Kretzschmar and M. A. Smith*

90 Review of Recent USA Patents on Hydrazine and Substituted Hydrazines, *by Harold Shalit and Heinz Heinemann*

94 Processing Review, *by William C. Uhl*

102 Oil Company Staff Changes

104 International News and Notes

112 World Petroleum Statistics, February 1960

130 Advertisers' Index

THIS MONTH'S COVER

Evening on Michigan Boulevard, Chicago, where the American Petroleum Institute is currently holding its fortieth annual meeting. In the foreground is the Conrad Hilton Hotel which serves as headquarters for the convention. Color plates are reproduced through the courtesy of Richard F. Cook, editor of *Ethyl News*, house magazine of Ethyl Corp.

Washington Pipeline

by Joseph B. Huttlinger

Gas Bill Revived

The drive for a natural gas bill is picking up with the Federal Power Commission's decision in the case of the Phillips Petroleum Co. The FPC appealed in the decision to Congress to enact a law to clear up the method of control over prices at which the independent producers may sell.

The appeal was only implied. It came as the commission threw out the cost-plus method of setting produced prices in favor of price ceilings by area. The cost-plus method, said the FPC, would bring "ridiculous results" and "fallacious results."

The commission said: "We fully realize that some persons will contend that the plan of rate regulation we here announce is not lawful and that we are bound by City of Detroit v. FPC . . . to calculate a rate base and determine a rate of return, at least as a point of departure."

The commission then made one of the most effective statements recently that the price of gas to the producer is too low, in saying: "In fact, rigid adherence to the rate base method will, in many cases, price the producers' gas completely out of the market. "This fact is abundantly clear. Regardless of variations in allocation methods, allowance for incentives, and other disputed factors, computations of the cost of natural gas which have been presented in the many cases before us, show that natural gas has been, in almost all instances, substantially underpriced."

Independent producers already are using the words of the commission as a springboard as they press for legislation next year to clear up the matter. If a drive gets started, consumer groups are sure to come in and ask Congress to force the FPC to use cost-plus controls. In view of the commission's vigorous rejection of this method, however, they are not likely to get far.

Gasoline Tax Hike Studied

Candidates for Congress and the White House aren't talking about it, but the chances are U. S. motorists will be asked next year to pay another penny a gallon in federal gasoline taxes. Object of the hike would be to rescue the 41,000 mile interstate highway program from financial troubles that have overtaken it in only four short years.

Raising the federal tax to five cents may be difficult as public confidence is to be shaken further when a special House Public Works subcommittee resumes hearings on charges of corruption and waste. Chairman John A. Blatnik, D., Minn., hinted that what's to come will make the past look like "a tea party."

$5.3 Billion in Gasoline Tax

State and federal taxes on gasoline took in $5,346,403,000 in the fiscal year ended last June 30, it is reported. States collected $3,332 million, a gain of nine per cent from a year earlier. This comes to $18.81 per person. Uncle Sam took in $2,014 million, up from $1,700 million.

O'Mahoney Bows Out

Sen. Joseph C. O'Mahoney, D., Wyo., bows out of Congress in January after 26 years, with an appeal for help to the U. S. independent producer of oil and gas. But he feels it is "ridiculous" to allow the incentive of the income tax depletion allowance to foreign production of U. S. companies, which is increasing "at a very large pace."

Mr. O'Mahoney foresees a "revamping" of the oil import program, which he calls "not satisfactory to the industry at all," but he declines to spell out the revamping needed. With the entry of Russia into world oil markets, "this is a time for leadership by oil men" he feels. He believes that Russia is carrying on "economic war against us" and that "if we meet it on an economic basis we will be alright." He sees heads of international oil companies caught between Russian efforts which tend to force down prices and the drive of Middle East and other producing countries to hold up prices and thus profits. He said Middle East countries want a hand in "price manipulation." He says the oil industry today is more competitive than in years, due to oversupply, slowing up the rate of increased demand in the U. S., and the entry of natural gas into fuel markets.

Canada and US Depletion

The U. S. income tax percentage depletion law provides an incentive for a U. S. firm operating abroad to set up a branch rather than a foreign corporation.

This is set forth in a publication of the Canadian-American committee entitled "Law and United States Business in Canada," naming sources of friction between the two countries. The depletion provisions of 27.5% for oil and gas apply to U .S. corporations, but not to incorporated foreign subsidiaries of U. S. firms, the report explains.

US Oil Payments Drop

Bureau of Land Management payments to the states from mineral leases, including oil and gas, dropped to $18,960,278 in the first half of this year, against $20,817,262 a year earlier, it is reported. The state share is 37.5% of all incomes to the government from rentals, royalties and bonus bids from federal mineral leases. The drop is attributed as due to fewer rentals, royalties and bonuses.

US Has Air Pollution Control

The fight against air pollution was given new emphasis recently as the Public Health Service created a new Division of Air Pollution to handle it.

Vernon G. MacKenzie, a career engineer officer of the service, who has been engaged in air pollution control for the past 10 years, is the chief of the division.

Dr. Richard A. Prindle, a physician, who has specialized in the health aspects of air pollution and has been chief of the service's air pollution medical program for the last two years, is the deputy chief of the new division.

Refining Profit Grows

The petroleum refining industry is one of the few that showed higher profits after taxes in the second quarter of this year than a year earlier. The after-tax profits were $623 million, a slight gain from the $621 million in the same period a year earlier. First quarter of 1960 profits were $684 million.

Sales in the second quarter of this year were $7,002 million, well above the total of $6,601 million a year earlier. First quarter 1960 sales were $7,262 million. This is reported jointly by the Securities and Exchange Commission and the Federal Trade Commission.

Pipeline Profits Fall

Oil pipe lines are feeling the squeeze on profits. Barrels of oil originated on oil pipe lines in the second quarter of this year rose 2% to 1,166,317,113. But transportation revenues rose only 1.3% to $176,169,831.

Gas Rates Set by FPC

In a historic decision, the Federal Power Commission has set the "maximum acceptable rates" for pipeline quality gas produced in 21 areas of the United States. The rates range from 1.27 cents per thousand cubic feet for gas in the San Juan Basin of New Mexico to 26.8 cents per thousand in West Virginia for initial sales. A lower maximum was set in west areas for gas being sold under existing contracts to limit the amount of rise in the future.

The area ceilings indicate rates that will be acceptable to the commission, the FPC said in a policy statement, its first major one on the subject since 1954 when the U. S. Supreme Court told it to take control over rates of independent producers of gas. The statement added that initial rates higher than the ceilings and rate increases piercing the ceilings will be rejected by the commission.

The FPC said that when asked the commission will consider rates that pierce the ceilings on the basis of the "financial requirements of the individual producers" and that its decisions will set "a price for the gas itself from any source" and not necessarily for the individual producer.

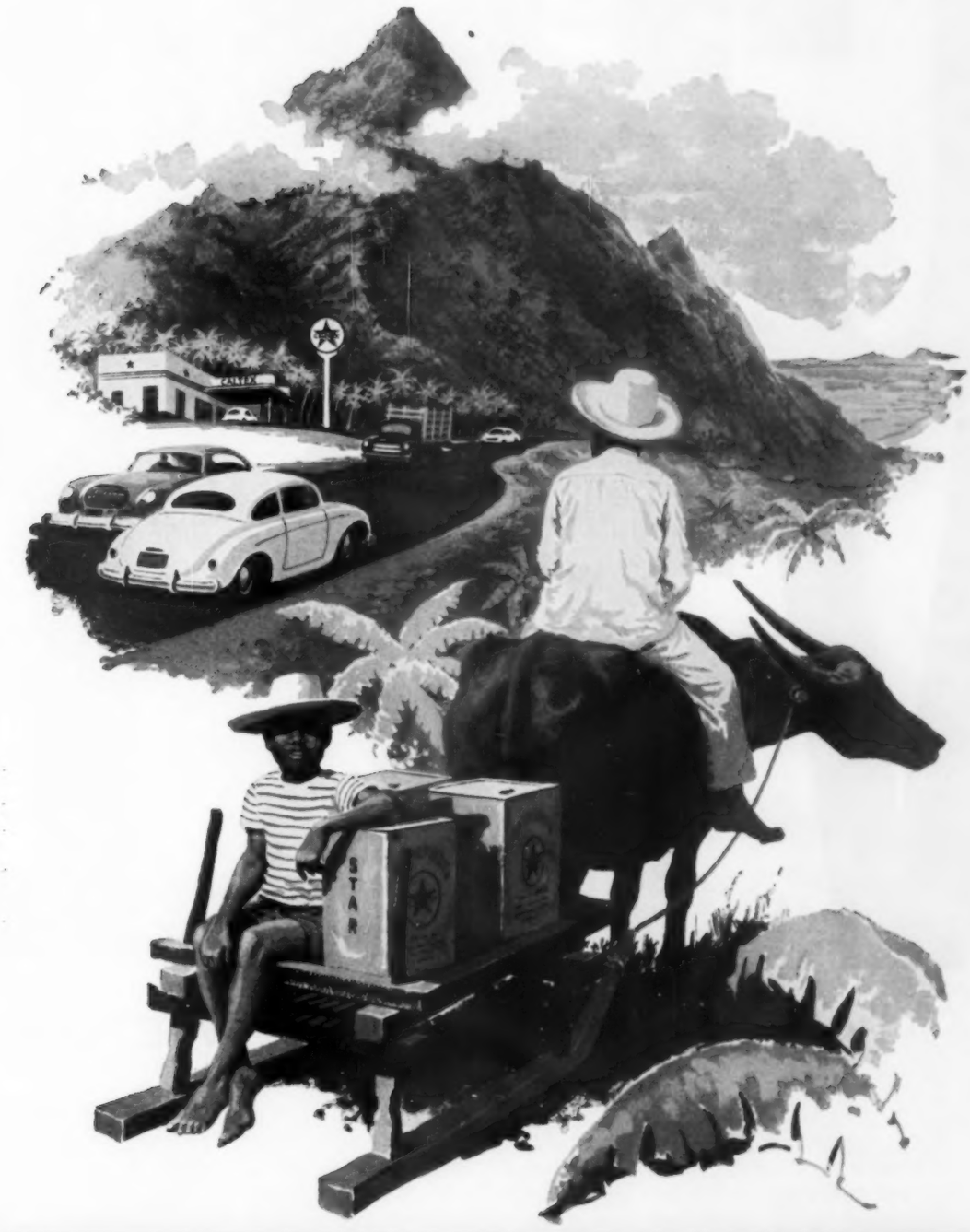
The ceiling prices were set on the basis of cost information in FPC cases, existing and historical price structures, volumes of production, trends in production, price trends in the various areas over a number of years, trends in exploration and development, trends in demands and the available markets for gas.

Area price levels for natural gas sales by independent producers for (1) new sales and (2) existing sales. All rates at 14.65 psia.

Area	Initial Service Rates/MCF	Increased Rates/MCF
Texas		
District No. 1	15.0	14.0
District No. 2	18.0	14.0
District No. 3	18.0	14.0
District No. 4	18.0	14.0
District No. 5	14.0	14.0
District No. 6	15.0	14.0
District No. 7-b	14.0	11.0
District No. 7-c	16.0	11.0
District No. 8	16.0	11.0
District No. 9	14.0	14.0
District No. 10	17.0	11.0
Louisiana		
Southern	Not determined	13.7 (14.0 @ 15.025 psia)
Northern	16.6 (17.0 @ 15.025 psia)	13.7 (14.0 @ 15.025 psia)
Mississippi	Not determined	13.7 (14.0 @ 15.025 psia)
Oklahoma		
Panhandle Area	17.0	11.0
Other	15.0	11.0
Carter-Knox	16.8	11.0
Kansas	16.0	11.0
New Mexico		
Permian Basin	16.0	11.0
San Juan Basin	12.7 (13 @ 15.025 psia)	12.7 (13 @ 15.025 psia)
Colorado	14.6 (15 @ 15.025 psia)	12.7 (13 @ 15.025 psia)
Wyoming	15	12.7 (13 @ 15.025 psia)
West Virginia	26.8 (28 @ 15.325 psia)	23.9 (25 @ 15.325 psia)

Gulf Postpones Oil Suit

Gulf Oil Corp., which is attacking the government's method of allocating product imports, asked and received a postponement until sometime in December for hearing on its appeal before the U. S. Court of Appeals, Washington, D. C. Gulf said the postponement was asked as the Oil Imports Administration is reported considering changes in the present method of allocating residual oil imports.



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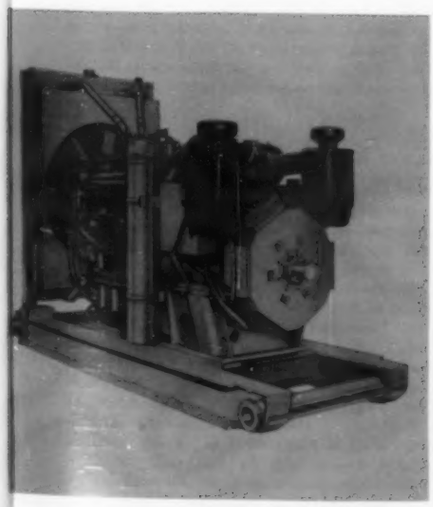

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18% Rise in UK Oil Consumption

The curve of deliveries of petroleum products into UK consumption (excluding bunkers for ships engaged in the foreign trade) continues to rise steadily, the total for the first half of 1960 being 157.1 million bbl according to returns collated independently for the UK Petroleum Industry Advisory Committee—a rise of 24.2 million bbl (18.2%) over the corresponding 1959 period.

Fuel oil again accounts primarily for the big rise. Excluding refinery consumption, the January-June total of 59,363,000 bbl represented a rise of no less than 13,347,000 bbl (29.0%) over the 1959 period. All main products contributed to this increase, however, except kerosine. There was a particularly large rise in "other products." Of the total "other products" 8,986,000 bbl (against 5,817,000 bbl in 1959) represented oils which are largely chemical feedstocks and products supplied to the gas industry.

The statistics, issued in long tons and converted to barrels by this journal, are summarized thus:

	1960		1959	
	1,000-bbl	Per cent	1,000-bbl	Per cent
Aviation fuels	7,240	4.6	6,448	4.9
Motor spirit[a]	31,641	20.1	29,157	21.9
Industrial[b] and white spirits	1,693	1.1	1,544	1.2
Kerosine	7,029	4.5	7,260	5.5
Lubricating oil and grease	3,371	2.1	3,073	2.3
Diesel engine road fuel	9,263	5.9	8,086	6.0
Gas/diesel oils	13,083	8.3	11,802	8.9
Fuel oil[c]	70,334	44.9	56,065	42.2
Other products	13,429	8.5	9,413	7.1
Total	157,083	100.0	132,848	100.0

Notes: [a]Includes motor benzole. [b]Includes industrial benzole. [c]Includes refinery fuel consumption: 1960—10,971,022; 1959—10,049,069.

Other points disclosed by the detailed return are the rise of 11.2% in deliveries of motor spirit to dealers, while those to commercial consumers fell 0.9% owing to the continuing changeover to diesel-engined vehicles, the rise in the proportion of sales of premier grade petrols, which make up almost two-thirds of total sales; the rise of 2.6% in deliveries of burning oil (kerosine) despite the generally mild weather; and the effect of the growing use of diesel tractors, resulting in a drop of 22.4% in the deliveries of vaporizing oil grade of kerosine.

Equipment Orders on the Rise

The resurgence seen in the first quarter of this year (see WORLD PETROLEUM, Aug, 1960, p. 10) in the value of orders for materials and equipment placed in the UK by oil companies is supported by the half-year's figures. The total (excluding tankers) according to figures published by the Council of British Manufacturers of Petroleum Equipment and collected by the Oil Companies Materials Association is £60,628,367, an increase of £3,958,184 (7.0%) over the first half of 1959. Last year there was a decline of £9,322,915 (14.1%) as compared with the first half of 1958. It would appear at this stage that there is every reason to expect the 1960 total to exceed last year's £117¼ million, the peak being the £134.1 million for 1957.

Once again, by far the highest category is that of bulk chemicals, catalysts, barytes and the like—£14.4 million, or a rise of £1.7 million (13.0%) over the 1959 period. Specialized equipment for refining, at £2.8 million, shows a rise of £1.1 million (60.7%), but orders for specialized equipment for drilling (including casing, tubing, etc.), with a total of £4.7 million, was lower by £1.1 million (18.3%). Orders for tubulars, pipe fittings and valves, at £5,782,225, were higher by £114,304. It is estimated that some 60% of the half-year's expenditures was for orders for use overseas.

BP's Angle Bay Terminal in Use

British Petroleum's new £6½ million terminal at Angle Bay in Milford Haven (South Wales) was brought into regular use the end of August with the arrival of the 42,000-dwt "British Statesman" with 39,000 tons of Middle East crude for Llandarcy refinery, linked by a new 60-mile pipeline with a capacity of 5,000,000 tons/yr.

This 2,500-yd long "T" shaped jetty, capable of berthing 100,000 tons of shipping at a time, was designed by the London consulting engineers Rendel, Palmer and Tritton. The main problem was to design a berth, which had to be built on an irregular rocky bottom, in 80 ft of water at high tide, and yet strong enough to take the berthing impacts from tankers up to 100,000 dwt. The problem was solved by designing the main berthing heads as solid concrete piers, each carrying four 100-ton shock-absorbing gravity fenders.

ICI—Montecatini Agreement

Imperial Chemical Industries has signed a patent license with Montecatini Soc. Generale per l' Industria Mineraria e Chimica, of Milan, for the exclusive production in the UK of staple fibers, filament yarns and textile monofilaments from polypropylene. No information as to production plans is yet announced.

ICI is already licensed by Montecatini to produce polypropylene for use as a plastic under an agreement announced in early 1959. Plans to make this material under the name "Propathene" were put into effect speedily at the Wilton Works and a 20 million lb/yr plant will be on stream this year.

With the new agreement, ICI can now make both fibers and plastics under Montecatini or Montecatini-Ziegler British patents.

BP Bid for Apex (Trinidad)

British Petroleum Co. has made an approach to the board of Apex (Trinidad) Oilfields Ltd. with a view to acquiring the whole of its £1.1 million issued ordinary capital in 5s stock units. The actual terms of offer have still to be released.

General opinion is that BP is anxious to lessen its dependence on the Middle East by broadening the basis of its Western Hemisphere operations and to extend its holdings in Trinidad. It already owns 77% of Trinidad Petroleum Development shares and 33-1/3% of Trinidad Northern Areas. These two together produce about 1½ million tons of crude a year, while Apex output is around 430,000 tons. Further, the 25% interest which Apex holds in Canpet Exploration (50% owned by Ultramar) would tie in with BP policy of expansion in Canada through Triad Oil.

ICI Acquires US Boron "Know-How"

Imperial Chemical Industries has concluded an agreement with the Callery Chemical Co., of Pittsburgh, which provides for an exchange of "assessment information on certain aspects" in the field of boron compounds. This exchange has in view the acquisition by either party of non-exclusive royalty-bearing licenses under the other party's patents, as requested. Callery Chemical, a joint subsidiary of Gulf Oil and Mine Safety Appliances Inc., is a leader in the industrial application of boron compounds and a pioneer in the field of boron chemistry applied to high-energy fuels.

Butane from Coryton Refinery

Mobil Oil Co. has now added butane to the range of products available from its Coryton (Essex) refinery, and the first bulk delivery was made towards the end of August. Propane has been available since the completion of the first stage of a large liquefied gas recovery unit earlier this year.

Large Tanker for Stevinson Hardy

A 47,200-dwt steam turbine tanker, the "Edward Stevinson," has been launched at Harland and Wolff's Belfast shipyard for Stevinson, Hardy and Co. Ltd. On completion, this will be let under time charter by demise from Stevinson, Hardy (Tankers) Ltd. to Shell Tankers for a 20-year period.

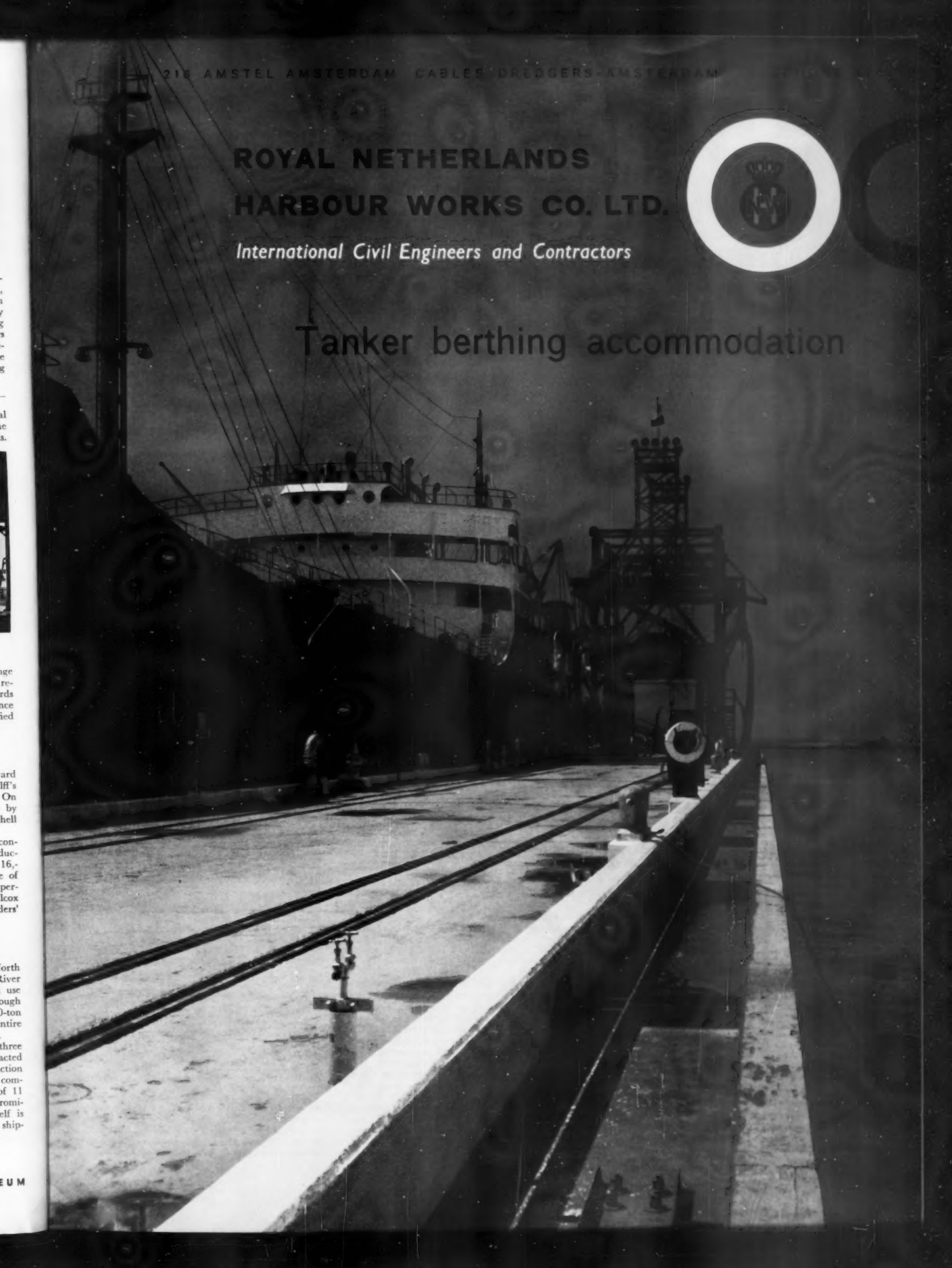
The Harland and Wolff propelling machinery consists of a single screw arrangement of double reduction, articulated-type, geared turbines, developing 16,000 shp in service. Steam at a working pressure of 600 psi and a total temperature of 900 F at the superheater outlet is generated by two Babcock & Wilcox "Selectable Superheat" water tube boilers of builders' make.

Tanker Repair and Construction

An 850-ft quay under construction at the North Dock, Sunderland, for T. W. Greenwell Ltd., River Wear ship repairers, will be in full operational use by the year end for medium-sized vessels, although ultimately it is designed to accommodate 65,000-ton tankers. This project, which has involved the entire reconstruction of the dock, has taken three years.

Inchgreen Investigating Co., after nearly three years' efforts, may soon announce that the protracted negotiations to raise £4¼ million for the construction of a large graving dock on Clydeside have been completed. This company represents a consortium of 11 Greenock shipbuilding and engineering firms. Prominent among these is Lithgows Ltd., which itself is expanding and modernizing its Port Glasgow shipyards to build large tankers up to 60,000 tons.

(*Continued on page* 10)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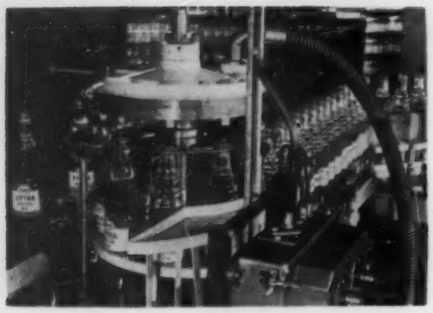


Oil Packaging at Esso Terminal

New lubricating oil packaging equipment has been installed at Esso Petroleum's Mode Wheel terminal which can fill pint and quart size bottles at the rate of 60 per minute. This has reduced the floor space required, increased station potential capacity by 100%, and reduced the number of operators from eight to three, two of whom pack the bottles into crates.

The layout drawing was worked out by Mather and Platt Ltd., Manchester, in conjunction with Esso. The other main equipment suppliers were Dawson Bros. Ltd., Leeds, and Fords (Finsbury) Ltd., London. After the washing stage supplied by Dawson Bros., the next, that of filling, utilizes a Mather and Platt unit, a positive-displacement (gear) type pump whose principle is that of time fill at constant flow rate, with accuracy achieved by fine tolerances and careful spacing of nozzles in the filling head in relation to each other. Accuracy is ensured by PIV gear incorporating a positive nonslip belt. Capping with aluminum foil is by a Fords rotary sealer, with both filling and capping machines driven by a common motor controlled by an Alan West starter. Equipment is reported to be working very satisfactorily, and it will shortly be at full capacity with the installation of a separate crate-washing machine. This terminal is used for distribution in the Midlands and north England.

Powell Duffryn Oil Storage Expansion

Powell Duffryn Ltd. is studying further possibilities of developing oil storage elsewhere in the UK, the chairman recently said, who announced that the company had purchased a small company at Birkenhead with scope for expansion to about 25,000 tons of storage.

Distillers' Progress in Petrochemicals

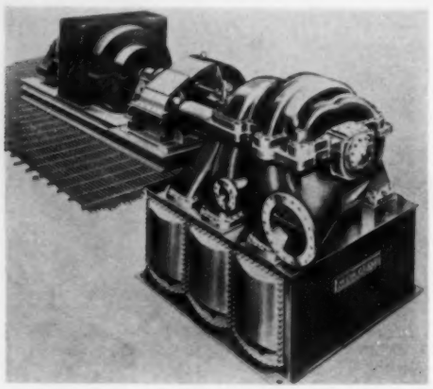
Progress in petroleum-chemical interests is reviewed in the annual statement of Distillers Ltd. issued recently. Three new plants were commissioned by British Hydrocarbon Chemicals (BHC) during the year. That for producing high density polyethylene presented a number of teething problems but these are now being steadily overcome and production of specification material is now fully established; and two other units —for producing cumene and phenols—are now operating to full capacity. Three other BHC major projects are now in hand: these are for a new plant to produce methanol, a substantial increase in butadiene output, and the production of ethylene dichloride for use by Distillers' plastic division in the expanding manufacture of polyvinyl chloride resins. In June BHC also successfully commissioned a new cracking plant with a capacity of 70,000 tons/yr of ethylene.

Forth Chemicals and Grange Chemicals had good years and the former has decided on a further increase in styrene production which should be in operation by the year end. British Geon has a further substantial increase in polyvinyl chloride capacity and is also increasing its production of "Hycar" oil resistant synthetic rubbers. British Resin Products had a good year in promoting sales of "Rigidex," the new BHC polyethylene which is finding increasing acceptance in a number of fields, and another expansion is that of polystyrene by Distrene Ltd.

US Equipment Links

Vickers-Armstrongs (Engineers) Ltd. has reached an agreement with Racine Hydraulics & Machinery Inc., of Racine, Wis., whereby the two companies will jointly develop their hydraulic interests and manufacture and sell each other's hydraulic products on a world-wide basis. Racine is one of North America's leading hydraulics manufacturers, producing equipment ranging from individual pumps and valves to complete power and package units working at both high and low pressures.

Elliott Brothers (London) Ltd. has secured a license from General Kinetics Corp., of New Jersey, to manufacture and sell certain of the latter's valves, notably the P-K Paul valve, in the Eastern Hemisphere. In return General Kinetics receives sole distribution and servicing rights for certain Elliott-Automation group equipment in the Western Hemisphere. The main object of the arrangement is to give Black Automatic Controls Ltd., a comparatively new Elliott acquisition, an outlet to the U. S. market.



G. & J. Weir Ltd., of Cathcart, Glasgow, has been licensed by Clark Bros Co. Division of Dresser to manufacture the Clark line of "Isotemp" packaged centrifugal air compressors. Their distinctive feature is the integral between-stage intercooler system built into the base and the seven frame sizes of Weir-Clark "Isotemp" compressors, ranging from 5,000 to over 50,000 cfm, will provide highest purity primary 110 psi air.

A. P. V.-Paramount Ltd., subsidiary of the A. P. V. Co. Ltd., of Crawley, Sussex, has secured a licensing agreement with Sivyer Steel Casting Co., of Milwaukee, for the manufacture of Sivyer refinery process heater fittings in Europe and the British Commonwealth.

Head Wrightson & Co. Ltd. has issued a brochure—"Demineralization Plant"—describing briefly the Belco water treatment processes and applications it can now offer as a result of the recent agreement with the Belco Industrial Equipment Division of Bogue Electric Manufacturing Co., of New Jersey.

British Equipment News

G & J. Weir Ltd. has acquired the complete compressor business of Alley and MacLeblan (Polmadie) Ltd. and within the next few months the production of "Alley" units will be transferred from Polmadie to Weir's works at Cathcart, Glasgow.

Richard Costain Ltd. and Wm. Press & Son Ltd. Jointly announce the formation of two companies—Costain and Press (Overseas Services) Ltd. and Costain and Press (Overseas) Ltd.—to undertake construction projects in all parts of the world in which the civil engineering and building experience of Costain can be allied to the mechanical engineering and pipeline construction experience of Wm. Press. Offices of the new companies are at 111 Westminster Bridge Road, London, S.E.1.

Chicago Bridge Ltd. has started shipment for a contract received on behalf of Esso Standard (Libya) for the supply, delivery and erection of four crude oil floating roof storage tanks, each of about 10-million gallons capacity. Measuring 200-ft diameter and 48-ft high, these are being made by *Whessoe Ltd.*, Darlington.

Murphy Radio Ltd. will design, supply and install a £1 million control system for the Burmah Oil Co.'s 800-mile oil pipeline in Assam and Bihat. This will govern telecommunications, telemetering, telecontrol and instrumental equipment over the whole line. Control will be automatic, with detection devices giving warning of blockages or leaks and summoning engineers through the system's own VHF equipment.

Stewarts and Lloyds Ltd. has received an order worth over £900,000 from Willbros (Overseas) Ltd., subsidiary of Williams Brothers Co., Tulsa, for 8⅝-in. outside diameter linepipe for the 280-mile products line from Shahrud to Meshed in Iran. S & L also supplied pipe worth over £800,000 for the first stage of this line—the 236 miles between Tehran and Shahrud—which is now nearing completion. It has also recently negotiated two Russian orders worth about £460,000 for 4,750 tons of seamless steel tubes.

After exhaustive tests, the Instituto Nacional de Tecnica Aeronautica—the official body for Spanish Air Ministry Specifications—has approved the use of "Intergard" for protecting aviation fuel storage tanks. This is the first of such finishes to gain this approval. It is made by *International Paints Ltd.* in various European countries and is used largely for protecting tanks in oil tankers.

Among several interesting vessels built recently in the Singapore yard of *John I. Thornycroft & Co.*, is a fire fighting and rescue launch for the Hong Kong government. With the three Thorncroft-Rover Meteorite diesel engines running at their collective continuous rating of 645 bhp, the boat exceeded its 22-knot contract speed, and at the collective maximum rating of 840 bhp over 24 knots was attained with additional equipment on board bringing the trial displacement up to 1½ tons above the contract data.

Appointments

B. R. FRASER has been elected to the board of Mobil Oil Co. Ltd. to fill the vacancy caused when **J. BLAKE MIDDLETON** retires early next year. He will be director in charge of marketing. After several years with Burmah Oil, Mr. Fraser joined Mobil in 1952 as assistant manager of the new Coryton refinery, becoming manager in 1954. He held this position until January, when he was appointed manager of the manufacturing department at head office.

B. R. Fraser

J. F. G. ARMAN, A. S. BRIDGEWATER, C. J. GEISS, R. L. HAYDEN and **J. McLEAN** have been appointed directors of Foster Wheeler Ltd.

C. E. H. VERITY, managing director, has been elected a director of the parent company, Foster Wheeler Corp.

J. McV. Luard

J. Moffatt

JOHN McVEAN LUARD, general manager of BP's exploration department, has been appointed a director of BP Exploration Co. Ltd., and **JOHN MOFFATT**, general manager of refineries department; a director of BP Refinery (Grangemouth), BP Refinery (Kent) and BP Refinery (Llandarcy) Ltd.

Amber Chemical Industries US Agreement

Last year Amber Chemical Industries Ltd. signed an agreement with the D. A. Stuart Oil Co. Ltd., of Chicago and Toronto, whereby it acquired the right to manufacture, blend and sell selected Stuart products in the UK and the Commonwealth. The Wolverhampton works have been further enlarged.

After centuries of toil - oil!

YESTERDAY — a warm house demanded a strong back and plenty of attention to keep those early furnaces and stoves stoked up with coal — the principal source of heat for many decades. Then along came a labor-saving solution to this heating problem — the introduction of fuel oil.

TODAY — silently, efficiently, automatically, oil heats over 16-million homes in the United States. Annually, this country consumes nearly 2½-billion dollars worth of oil for home heating — making petroleum one of the most basic and vital household commodities. Texaco is one of the principal suppliers of fuel oil.

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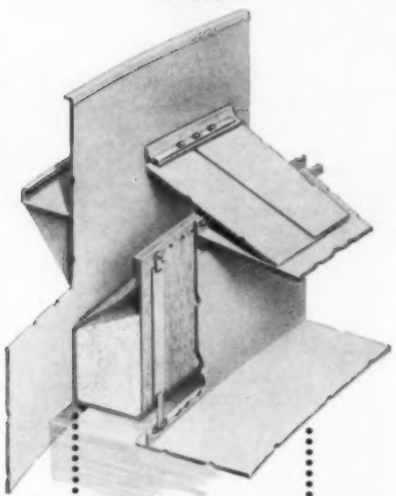

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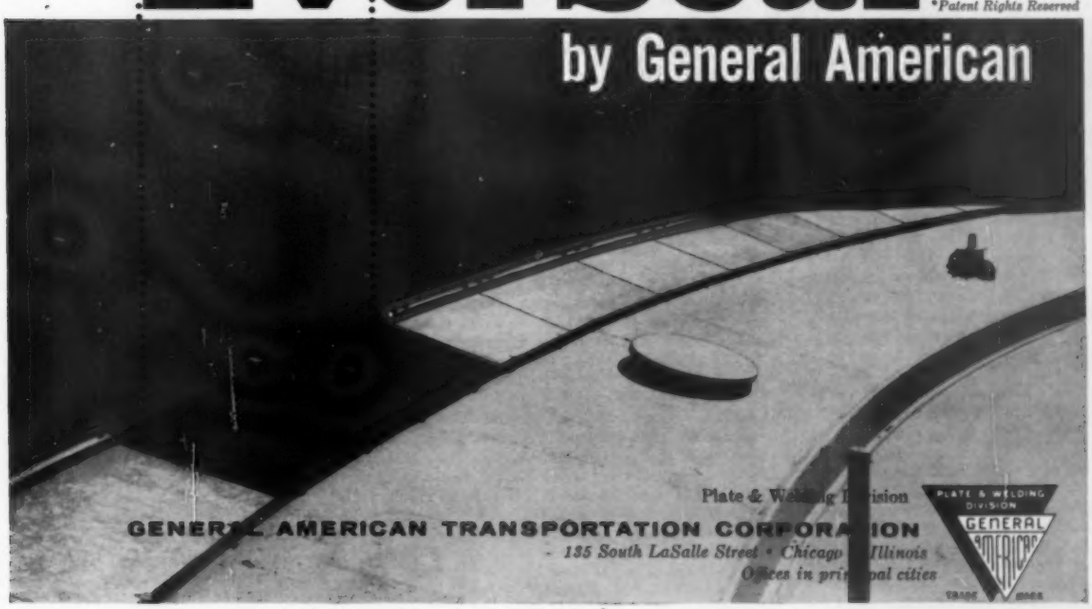
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CANADIAN NOTES

Montreal Pipeline Favored

A strong argument in favor of an Alberta to Montreal crude oil pipeline was presented in a talk before the Edmonton Chamber of Commerce by Charles S. Lee, president, Western Decalta Petroleum Ltd., in a continuation of discussions on the proposal. The Edmonton group had heard arguments against the line by Vernon Taylor, vice president of Imperial Oil Ltd. in a previous meeting. (See WORLD PETROLEUM, September, 1960, page 14). The pipeline has been proposed by a group of independent oil companies including Western Decalta and Home Oil Co. Ltd., both of Calgary, Alta.

A pipeline system of moving western Canada's crude oil to eastern Canadian markets is the most desirable means of raising the present level of production of Canadian crude and helping the country make itself as independent as possible of imports which may be subject to interruption, Mr. Lee said.

Taking up the question as to whether Western Canadian crude could compete in Montreal with offshore crude at present posted prices, Mr. Lee said:

"May I turn now for a moment to a point which seems to me of fundamental importance in our discussion. This is the statement made recently that there would be a 23¢ or a 39¢ per bbl disadvantage in the price of Redwater crude laid down in Montreal when competing with Venezuelan or Middle East crude."

He then showed the following tabulation of the laid-down per bbl price in Montreal of Venezuelan Oficina crude delivered by tanker and pipeline as compared with Redwater crude through a suggested transcontinental pipeline, using a pipeline tariff of 60¢ per bbl from Edmonton to Montreal:

Alberta Redwater Crude	
Wellhead price	$ 2.42
Transportation cost to Edmonton	0.073
Tariff, Edmonton-Montreal pipeline	0.60
Pipeline allowance	0.018
Total, laid-down, Montreal	$ 3.111
Venezuela Oficina Crude	
F.O.B. Puerto la Cruz	2.82
Tanker (USMC—55) to Portland	0.176
Insurance and loss	0.038
Tariff, Portland-Montreal pipeline	0.09
Pipeline allowance	0.017
Total, laid-down, Montreal	3.141

Mr. Lee added that detailed engineering studies have been made which indicate the Edmonton-Montreal-pipeline tariff could be as low as 52¢.

On the basis of the above tabulation, Canadian crude would be at a slight price advantage, not disadvantage, over the Venezuelan crude delivered in the same area.

"Having established the fact of an approximate parity in price of delivered crudes into the Montreal area, what are the other main arguments for delivery of, say, 250,000 b/d of Canadian crude oil into the Montreal area through a 30-in. pipeline?" Mr. Lee asked, "(1) We see our proposals as benefiting the entire country. The use of our own crude oil would redress substantially Canada's deficit in the balance of merchandise trade. The deficit last year was estimated by the Dominion Bureau of Statistics at $475 million. The estimated value of imported crude oil and products was $486 million. Due to the unprecedented increase in imports this year and the failure to keep foreign crude and products out of Toronto, and the decline in the premium of the Canadian dollar, this will probably increase in 1960. Let it be said at once that we do not presume that all crude oil and products would be eliminated by virtue of our proposals. But there are obvious substantial reductions which can be made.

"(2) Quite apart from the large investment in the construction of a pipeline there would be an immediate cash flow into Canada of over $300 million.

"(3) Concern has been expressed recently in many quarters at the amount of non-revenue earning investment in Canada. The production of crude oil would provide taxation and royalty revenues to federal and provincial governments in an estimated amount of an additional $90 million a year from investments which are more or less locked in at present. Funds would be freed to companies to supplement activities in the Northwest Territories and elsewhere.

"(4) Since the basic price of Canadian crude oil delivered into the Montreal area would be the same as that prevailing at the present time from Venezuela, there would be no need to change the cost of products to the consumer. Even now a study of consumer prices across Canada shows that the source of crude in any given area has no apparent effect upon consumer prices. Consumer prices seem to be established on an import parity basis with product sales in the USA; that is the cost of the product in the USA plus duty of about 18¢ per bbl. plus cost of transportation to the point of consumption.

"(5) The impact of products and imported crude from refineries in the Halifax area or elsewhere could be controlled by making an annual import allocation for these refineries in accordance with annual demand in a prescribed area, which if exceeded would automatically become supplanted by Canadian crude transported down the Montreal-Portland pipeline and thence by tanker to the Halifax refinery.

"(6) This point is by no means sixth in order of importance, but the industrial heart of our country should not be dependent upon politically unreliable sources of crude in time of emergency.

"(7) The infusion of so much revenue into the West and now going out of our country would react immediately upon the manufacturing centers of Quebec, whence are derived many of the goods requested for an expanding Western economy. One cannot resist the comment that the insistence of Eastern Canada to take offshore crude, exclusively from Venezuela or the Middle East is comparable to Western Canada insisting on taking offshore textiles exclusively from Japan.

"One further word: in 1956, Canadian wells had a potential of about 650,000 b/d and the market in February of 1956 was 470,000 b/d. In 1960 the potential is 1,250,000 b/d and the market in the first quarter was 530,000 b/d. Therefore, production capacity has increased about 100%, sales have increased about 13%. In early 1956 crude oil imports were running at about 220,000 b/d and in 1960 crude oil imports are expected to be 356,000 b/d. So, while sales of our own oil had only gone up 13% in four years, imports had increased over 60%. In this year alone, imports will probably be 11% higher than in 1959. This is perhaps the best possible illustration that foreign imports are making hay at the expense of our producing industry in the West."

Gas-Export Headaches

Alberta gas producers are not all happy about big export approvals. At least 23 processing plants have to be built at a total cost of $350 million to render wet gas into suitable form for pipeline acceptance. Many smaller companies feel they cannot raise the capital required, and some may be forced into mergers or cooperating agreements for plant construction.

Gas Pipeline Contracts Let

Clearing of pipeline right-of-way for a crash pipe laying program early next year to export Alberta natural gas to the USA is well under way.

Alberta Gas Trunk Line Co. Ltd., a provincial carrier, and Alberta Natural Gas Co. have awarded contracts for six spreads that add up to approximately 600 miles of main transmission and laterals in Alberta and Biritsh Columbia.

Alberta Gas Trunk has contracted work on five spreads in the province while Alberta Natural Gas has awarded a contract for its 107-mile stretch from the Alberta-B.C. boundary to the B.C.-Idaho border.

The five spreads in Alberta Gas Trunk system involve pipeline construction in the Foothills Division, running north-south in western Alberta.

Majestic Contractors Ltd. of Edmonton has contracts for two spreads including construction of 113 miles of 36-inch diameter line, 63 miles of 30-inch line, and 38 miles of 22-inch lateral.

Alberta Consolidated Pipe Line Builders will also work on two spreads, 113 miles of 36-inch line and 64 miles of 16-inch laterals. Alberta Consolidated is composed of a group of companies including Mannix Co. Ltd., Piggot Construction Ltd., Banister Construction Co. Ltd. and Marine Pipeline & Dredging Ltd.

The fifth spread in the AGT system is being built by Dutton-Williams Bros. Ltd. of Calgary for the 62-mile 30-inch line and the 20-mile, 22-inch lateral in north western Alberta.

Projected cost of the AGT Foothills Division is estimated at $90 million.

Price-Poole of Canada Ltd. has the contract for the 107-mile, 36-inch line in B.C. to be built for Alberta Natural Gas Co. Price-Poole is a joint operation of H. C. Price of Canada Ltd., Calgary, and Poole Construction Co. Ltd. of Edmonton.

Charles Pennypacker Smith, vice president and manager of Alberta Natural Gas Co., stated that all participating companies in the 1,400-mile big inch gas pipeline project from Alberta to California have been awarded contracts.

Contracts for the USA portion of pipeline were awarded to Oklahoma and Texas companies by Pacific Gas Transmission Co. and Pacific Gas and Electric Co., San Francisco.

Canadian Bechtel Ltd. is the engineering manager for the Alberta Natural Gas Co. job.

Alberta Natural will transport gas for both Alberta and Southern Gas Co. Ltd. and Westcoast Transmission Co. Ltd. for delivery at Kingsgate, B.C. and on to the USA. Some of Westcoast's gas will also be sold to British Columbia consumers.

Alberta Gas Trunk's main stream will "feed" Alberta Natural system and will also transport gas via a lateral line to The Montana Power Co. at the Montana-Alberta border.

Canadian Condensate to USA

Mid-America Pipeline Co. plans to construct next year a $21 million 405-mile 10-in. condensate pipeline between Chicago and Superior, Wis., which will connect with gathering systems being developed and the existing inter-provincial pipeline system in Alberta, Canada, to carry condensates into the Chicago area. Initially, the line will have three pumping stations and a daily capacity of 26,000 bbl.

Pacific Petroleums Trade

Phillips Petroleum Co. and Sunray Oil Co. (wholly owned subsidiary of Sunray-Mid Continental Oil Co.) agreed to trade their Canadian assets to Pacific Petroleums Ltd. for 6.6 million Pacific Petroleums shares, according to announcement of the three companies. Phillips would own 39% of Pacific Petroleum's total shares and Sunray 5.8%.

Imperial Income to Rise

W. O. Travis, president of Imperial Oil Ltd., expressed optimism that the company would have a better second half this year than last, but cautioned about "difficulties of forecasting even three or four months ahead in this businss." Biggest "unknown" is the weather. Company's net in first half of 1960 was $30,688,000, or 97¢ a share—up from $23,334,000, or 74¢, in the comparable 1959 period. An improvement in second-half net would push profits for all 1960 past the $54,525,665, or $1.73 per share, earned in all of 1959. Imperial, largest Canadian oil company, is owned 69% by SONJ.

Texas Firm Sets up in Canada

Hamilton Bros. Canadian Gas Co. Ltd., a subsidiary of Hamilton Bros. Inc. of Midlands, Texas, has set up a Canadian operating unit with headquarters in Calgary, Alberta.

The company plans an active gas and oil exploration program in Western Canada. In charge of the Calgary office is D. G. Whitaker, who has been transferred from the parent company's Amarillo office.

Personnel Changes

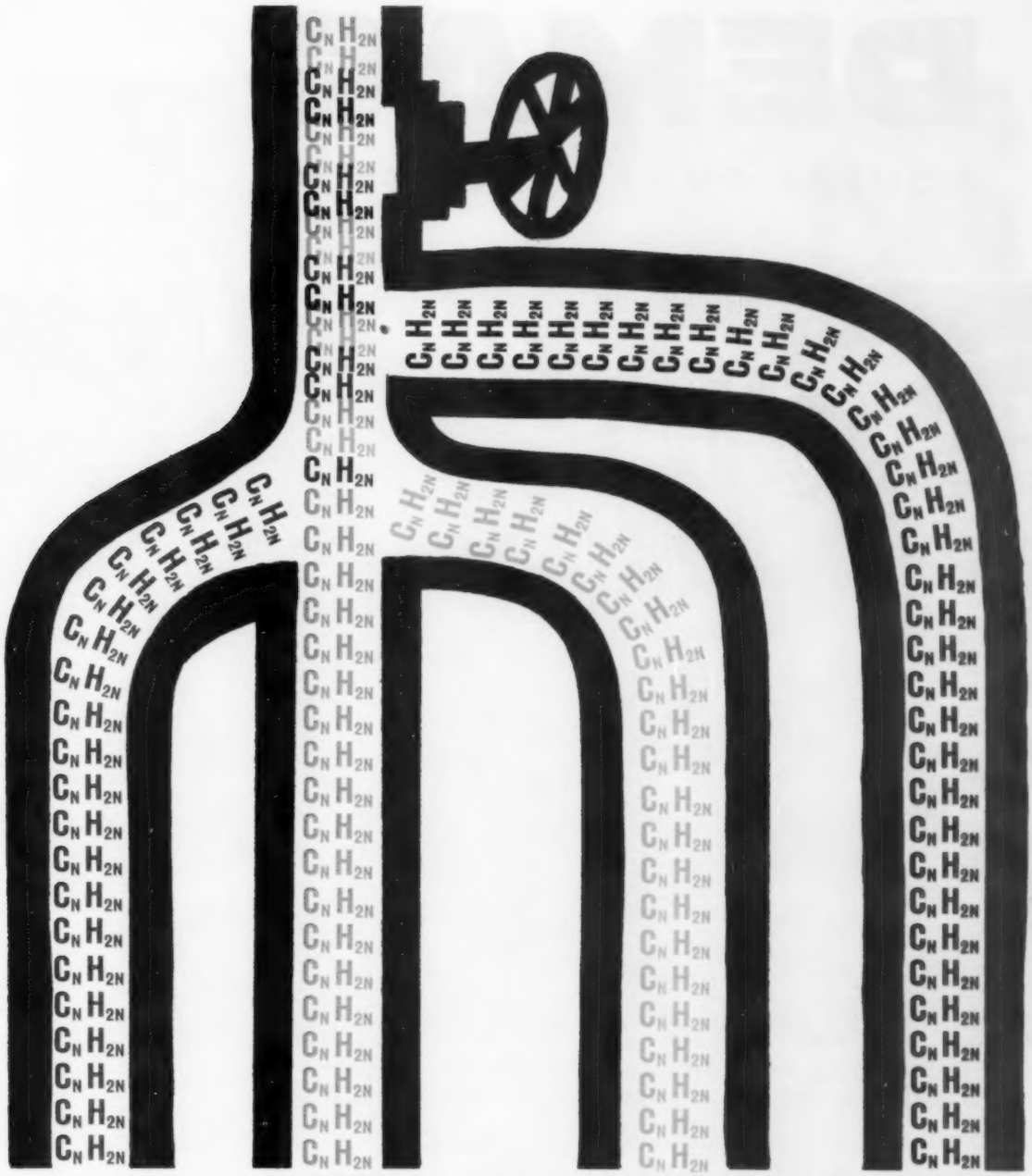
NORMAN R. CALLAWAY is the new manager of Imperial Oil's crude purchasing office in Calgary, succeeding **M. J. HUFFMAN** who becomes management assistant in the transportation and supply department at Toronto.

E. E. MOORE to general manager of Gardner Bros. Drilling Co. Ltd.'s Canadian operations with headquarters in Calgary. He replaces **W. R. HARRINGTON,** vice president, who transferred to the head office in Dallas, Texas, to assume broader duties.

JOHN BLIGHT has been appointed treasurer of Interprovincial Pipe Line Co. He succeeds **D. G. WALDON,** who was appointed assistant general manager of the company last year.

O. L. JONES has been promoted to president of The Consumers' Gas Co., Toronto, succeeding **A. L. BISHOP** who becomes chairman of the board. Mr. Jones was formerly vice president and in his additional duties, retains the position of general manager.

A. W. BALLY to senior geologist in charge of Shell Oil Co. of Canada's stratigraphic and special studies sections in Calgary, succeeding **PETER FITZGERALD-MOORE** who became head of exploration services, E. P. Division, in Bataafse Internationale Petroleum Mij., The Hague.



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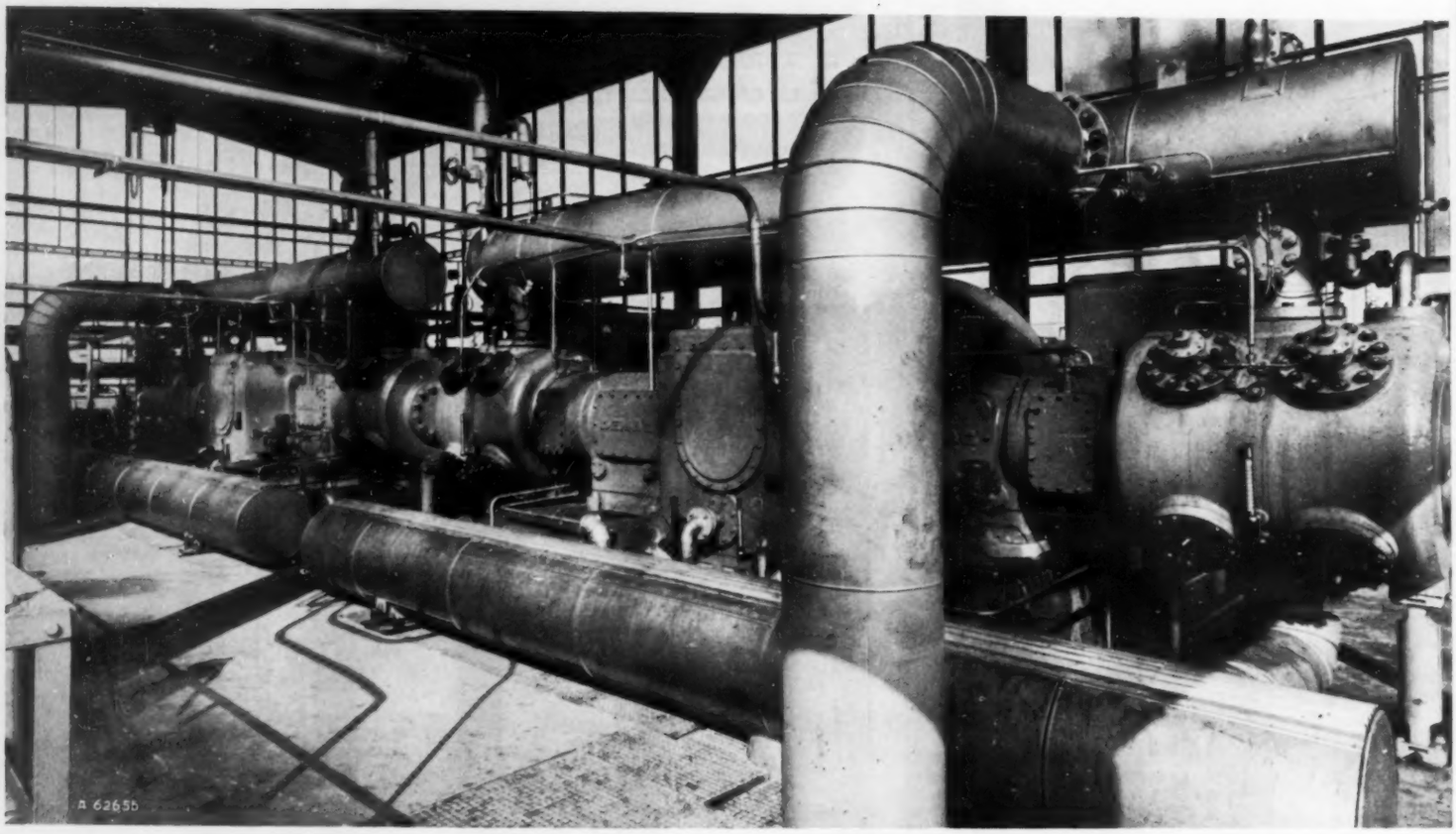

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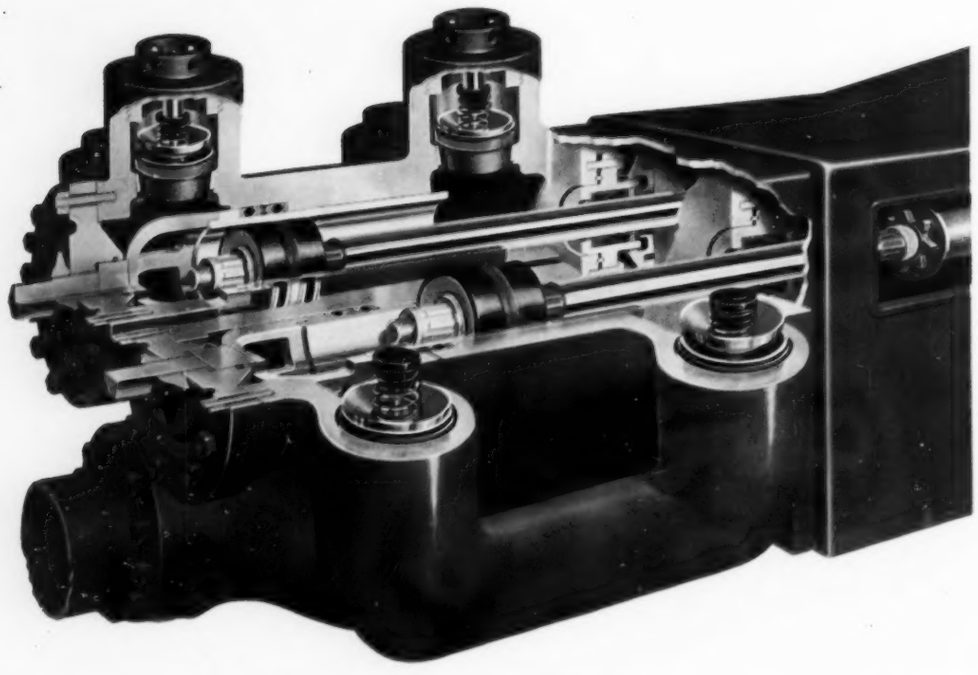

This cutaway view of a mud pump shows where the vital Mission fluid-end parts fit and why they are essential to correct operation. Forces on these parts are staggering. For example, pistons and rods may be subjected to forces of more than 100,000 pounds.

Liner packing and gland packing may be exposed to pressures exceeding 2000 psi, and valves and seats are required to stand violent impact every time they close.

Liners, also, are subject to "rocking," which aggravates both piston and liner packing wear unless all critical liner dimensions are held within API specifications.

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—M. J. Rathbone, President

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Standard Oil Company (New Jersey)

LATIN AMERICAN OIL NEWS

ARGENTINA—Argentina crude production in the first half of 1960 amounted to 27,138,000 bbl (149,934 b/d); estimate for all of 1960 is 58,500,000 bbl (160,274 b/d). Oil equivalent of natural-gas output for full year is estimated at 18,900,000 bbl—making total output 77,400,000 bbl. However, lack of gas pipelines makes it possible for only about seven million barrels of the oil-equivalent gas to reach consumers. Consumption is estimated at 81,900,000 bbl. Crude output in 1961 is estimated at 73,200,000 bbl; oil-equivalent gas at 20,800,000 bbl (only part of which has pipeline market outlet); and consumption at 95,000,000 bbl. Thus, signs are Argentina's deficit is closing.

ARGENTINA—An Italian dispatch reports SAIPEM (affiliate of ENI, Italian State oil agency) has signed a second contract for drilling in Argentina's Comodoro Rivadavia zone, with provisions similar to the first contract signed in 1958. Six hundred wells are to be completed by 1963 under extended payment terms—with 300 more wells possible.

ARGENTINA—Argentina's Yacimientos Petroliferos Fiscales is seeking a representative in Rio and offering 1% commission on his sales of petroleum products. More than 20 Brazilian firms have submitted applications. YPF's agent explains: Argentina aims to export surplus production in the second half of 1961. Kerosine, diesel oil, and other primary products of refining will be available, as well as crude petroleum. YPF has ceased to buy crude abroad for its own use, and private enterprises operating in Argentina will shortly cease to do so. YPF is intensifying exploration and research with the participation of private capital.

ARGENTINA—Upon Argentina government approval, a USA consortium is ready to begin immediate construction of a $74.5 million petrochemical complex at the deep-water port of San Lorenzo on the Rio Parana. Ultimate annual capacity is seen as 45,000 tons synthetic rubber, 11,500 tons carbon black, and 7,000 tons styrene in addition to amounts used in rubber production. The plants also will turn out 1,290 b/d of aviation alkylate and 839 b/d of benzene, plus intermediate chemicals. The plants—to employ 700 workers—will take 36 months to complete, with first units producing within 18 months. Companies involved include Continental Oil, Cities Service, U. S. Rubber Co., Witco Chemical Co., and Fish International Corp. (affiliate of Fish Engineering Corp.). An Argentine corporation, PASA, was formed earlier this year by the USA group to own and operate the plants.

BOLIVIA—After four years of exploratory drilling, Gulf Oil Corp. has announced a discovery about 30 miles northwest of the city of Santa Cruz on Gulf's Zone No. 1 concession of about 1,200,000 acres granted in 1956. The discovery well flowed 325 b/d of 50-gravity crude from perforations at 5,850 ft. The company added "a lower interval also tested oil of similar gravity, and other shallower prospects have not yet been evaluated."

BOLIVIA—Following the recent meeting in Mexico City between director-general Roldan of Pemex (Mexican State oil agency) and oil representatives of the Bolivian government, Pemex representatives will travel to Bolivia to continue negotiations which envision Pemex's entry into oil exploration, production, and refining in Bolivia.

BOLIVIA—Under a new agreement between Standard of California and Shell, the first of six wildcats (an 11,000-ft Devonian test 63 miles northwest of Santa Cruz) is currently being drilled to earn them a 50% interest in four concessions held 80% by Atlantic and 20% by Drilling & Exploration in Zone No. 1. However, Socal and Shell may withdraw from the agreement after drilling the wildcat.

BRAZIL—The Soviet Union will give Brazil technical aid in the construction of its first gas works operating on oil shale. The Brazilian SIRB company has concluded an agreement to this effect with the Soviet trade organization "Tyazhpromeksport." SIRB's president declared that his company wants to develop Brazil's oil-shale industry. Rio de Janeiro and Sao Paulo are the first cities to be supplied with gas. Brazil's President Kubitschek meanwhile has invited a group of Soviet shale experts for blueprinting and constructing the first experimental installations for the gasification of oil shale.

BRAZIL—One of the four private Brazilian companies which sought (and obtained against the wishes of Brazil's State oil agency Petrobras) rights to develop a Bolivian oil concession has completed its initial survey and is ready to drill its first test. Petrobras would like to develop the 20-year-old 2.8-million-acre Bolivian concession itself, but is barred from so doing by the Bolivian oil code which excludes foreign State-owned agencies from operating within Bolivia. Brazil acquired the oil rights in Bolivia in 1938 by treaty under which Brazil built a railroad for its neighboring country. Bolivia now has notified Brazil it must begin operations or relinquish the oil concession.

BRAZIL—Currently 62 rigs are operating in Brazil (including contract rigs). Because of high cost, averaging $1 million per unit with ancillary equipment, Petrobras will only lease rigs in the future (no purchases). Crude output during July and August was 85,000 b/d (official figure). Another oil field has been discovered near Alagoinhas in Bahia, where SE-2-BA (Sauipe) initially tested 700 b/d. Farther north, outside Reconcavo, oil was encountered at Ouricanguinhas wildcat. In August, drilling was started in at offshore well PJ-266 in Dom Joao field of All Saints Bay in Bahia province (for which Texas fire-controller Hansen was engaged) continued well into August. Exploration at present proceeds at five points: (1) near Manaus, at Autaz Mirim, on the Middle Amazon River; (2) between Alagoas and Sergipe in the estuary of Sao Francisco River, where two wells have small commercial productions; (3) near Itapetininga, in Sao Paulo's Paranapanema valley; (4) in Santa Catarina, in the Rio Cacador area; (5) in municipality of Dourados (in Mato Grosso) where oil shows recently were encountered in wildcats.

Petrobras estimates Brazil's refineries will process 218,000 b/d of crude by next December, sufficient for internal consumption. Private refineries process 56,000 b/d. Presidente Bernardes refinery (Cubatao) is raising its capacity to 110,000 b/d from 100,000; Landulfo Alves (Mataripe) to 52,000 b/d from 35,000. The projected Duque de Caxias (Rio de Janeiro) 90,000 b/d refinery is scheduled to start production in January 1961. Petrobras plans to start building the Minas Gerais refinery at Belo Horizonte this year, and the Rio Grande Do Sul plant at Porto Alegre in 1961.

Final agreement with the Soviet Union provides for purchase of 100,000 tons of diesel oil and 600,000 tons of crude—with Brazil's option to reduce the latter amount to 400,000 and make up the difference with diesel oil. The total import will cost US $10 million.

ECUADOR—Esso Standard (Inter-America) is moving into Ecuador. The SONJ affiliate has acquired a minority interest in Anglo-Ecuadorian Oilfields which produces, refines, and markets in that country.

GUATEMALA—A Guatemalan subsidiary of Canadian Shell has resumed construction of a refinery on Guatemala's Caribbean coast near Puerto Barrios. Construction work, which is being done by the Lummus Co., was held up recently, but briefly, through an injunction against the Canadian Shell subsidiary obtained by a Guatemalan company.

The Canadian organization promptly and successfully appealed the court order; and construction work, which started December 26, 1959, resumed. The refinery will represent an investment of about $5 million. Construction work will be completed and production started early in 1961. The relatively small capacity of 4,000 b/d will be distributed by Shell. Reconstituted crude from Venezuela or Curacoa will be utilized.

GUATEMALA—Delhi Guatemala Exploration Corp., subsidiary of Delhi-Taylor Oil Corp., has been approved by the Guatemalan government as operator for the El Peten group which is conducting exploratory activity in northwestern Guatemala. The group, composed of Delhi Guatemala Exploration Corp., Guatemalan Atlantic Corp., Guatemalan Sun Co. and Pure Oil Co. of Guatemala, has concessions in two areas comprising approximately 1,337,000 acres. The group to date has conducted only geological and geophysical operations.

MEXICO—General Idalio Sardemberg, president of Petrobras, headed a delegation of Brazilian petroleum experts to Mexico in August, and considered plans with the director general of Pemex to exchange Brazilian iron for crude oil and residual oil products. Sardemberg said Petrobras now produces 85,000 b/d of crude and requires twice that quantity. A petrochemical industry is to be established, and synthetic-rubber factory built. "We (the Latin American nations) will advance quicker if we help each other." The director general of PEMEX, Pascual Gutierrez Roldan, said Mexico's present crude production is 314,000 b/d. Except fuel oil (35,000 b/d), output is entirely sold abroad; but two plants nearing completion will produce 48,000 b/d, of which 13,000 will be available for Brazil.

A Mixed Commission is to be created for the interchange of information regarding the petroleum industry and technicians. It is hoped, by 1961, to arrange for cooperation between the chiefs of government oil enterprises in Brazil, Bolivia, Argentina, Peru, Venezuela, and Mexico as part of the plans for developing the Latin American common market.

MEXICO—Because it "would raise consumer gas rates," Pacific Lighting Corp., major supplier of natural gas to southern California, said it will fight Tennessee Gas Transmission's plan to build a $225 million natural-gas pipeline from south Texas through Mexico into the Los Angeles area. Tennessee Gas already has signed a contract with the Mexician government under which the company would build the $165 million section of the pipeline within Mexico.

MEXICO—Pemex, Mexican government oil agency, has announced addition of two tankers—boosting the Mexican tanker fleet to 20—as part of its vast plan for a pipeline and tanker marketing systems stretching north from the Isthmus of Tehuantepec to Mexico City and west from the Gulf of Mexico almost to the Pacific. Largest of the projected pipelines will be the 1,206-mile 34-in. line (capacity 750 mmcf per day) between Reynosa near the Texas border and Mexicali near the USA California border.

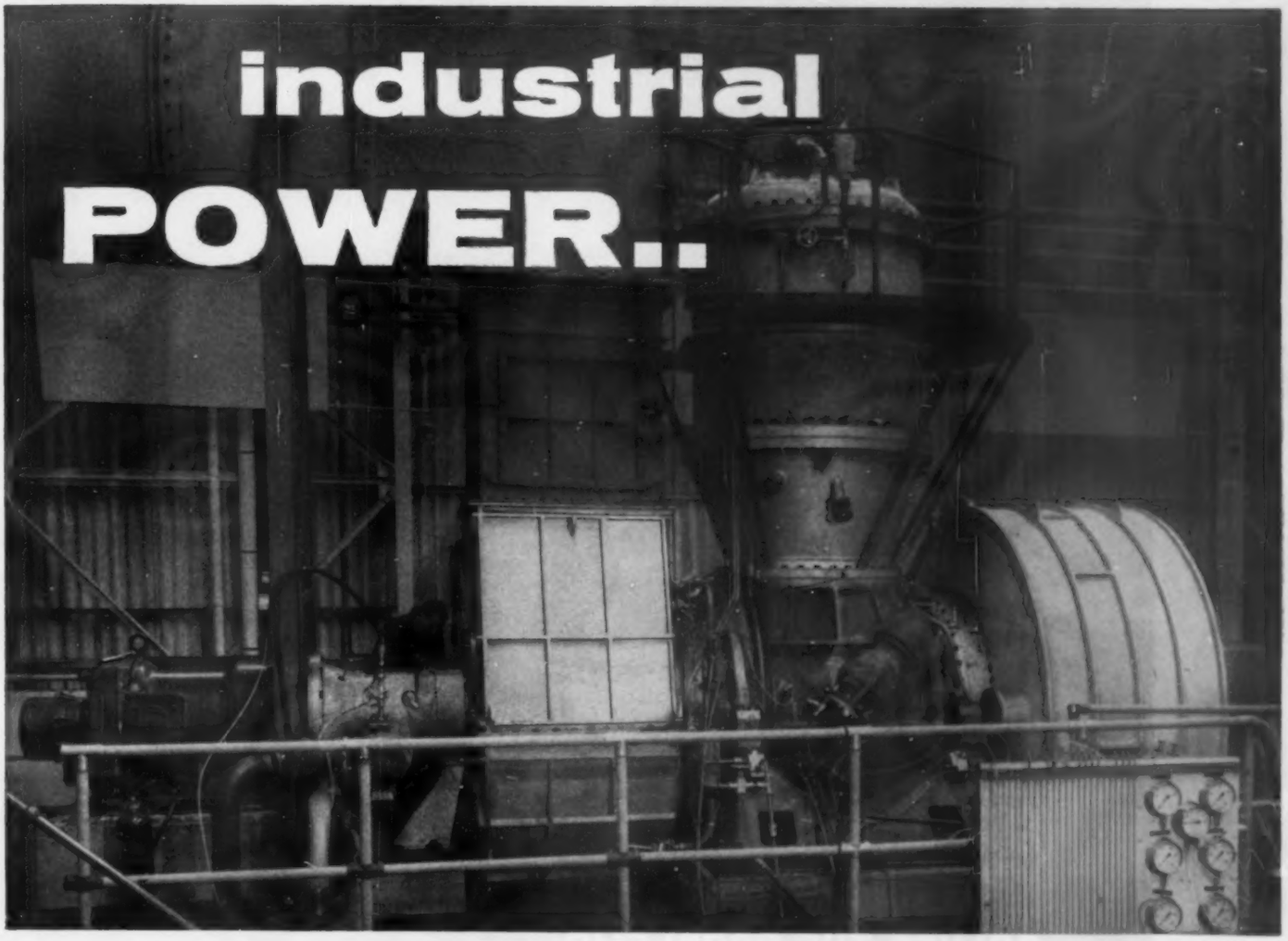
PERU—Peru's recent proposal to increase its share of oil profits to 60% (in a draft law now before the congress to alter the present 50-50 split) would require International Petroleum Co. to pay up to $44.8 million to continue its operations over the full 30-year period in its north coastal concessions, including an immediate payment of $10.1 million. International (SONJ affiliate) produces almost all of Peru's 50,000 b/d output.

PERU—The Peruvian government has sent its congress a measure which would enable it to reclaim in 30 years all the northern Peruvian oil rights owned by International Petroleum Co. (SONJ affiliate). The disputed rights were granted International in 1924. The measure asks immediate cash payment for profits made during past years and a share of the profits during the next 30 years. At the end of that time, the government would reclaim the oil rights.

TRINIDAD—The British Petroleum Co. has announced an offer to Apex (Trinidad) Oilfields to acquire the issued share capital of the latter company.

VENEZUELA — Oil-producing countries, alarmed over reductions in their revenues brought on by the recent cuts in Middle East crude prices, formed the "Organization of Petroleum Exporting Countries" at a meeting in Baghdad in mid-September. Members of the new organization include Venezuela, Iraq (which called the meeting), Kuwait, Saudi Arabia, and Iran. Observers at the meeting included those from Qatar, and the Arab League which will sponsor the second annual oil congress in Beirut in October. Though no specific goals have been released, Baghdad dispatches indicate the new organization will seek (1) raising of posted prices to level before recent cuts; (2) elimination of price fluctuations to insure stable and regular oil royalty income; (3) coordination of oil-production policies in certain instances. The last point probably envisions the controversial idea of Saudi Arabia's oil director-general Tariki for world-wide oil prorationing.

COMPACT industrial POWER..



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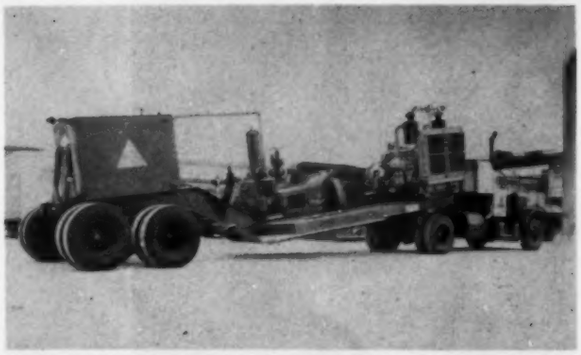

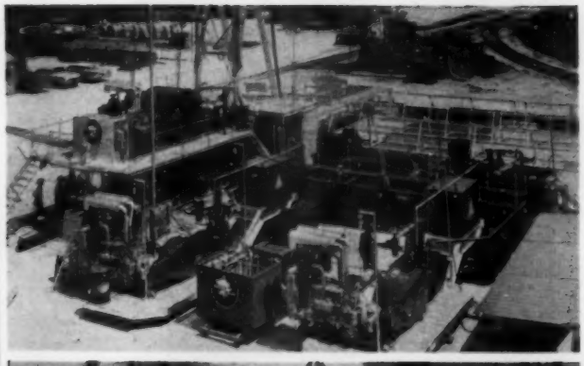

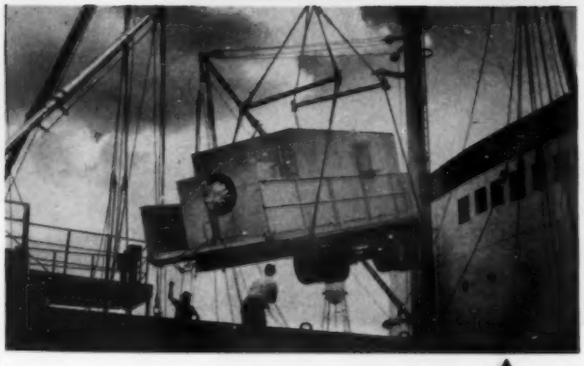

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EX001

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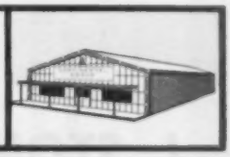

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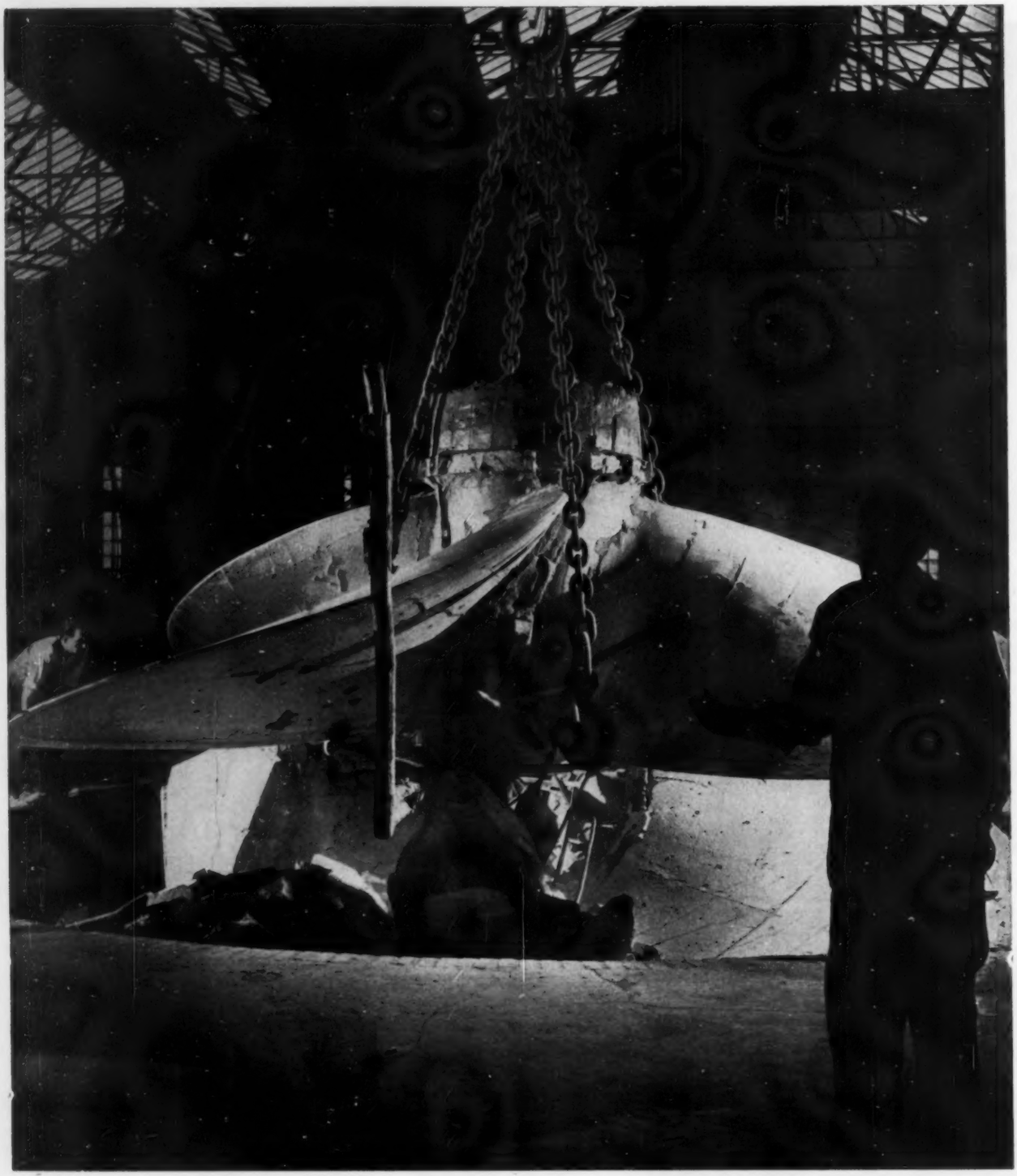

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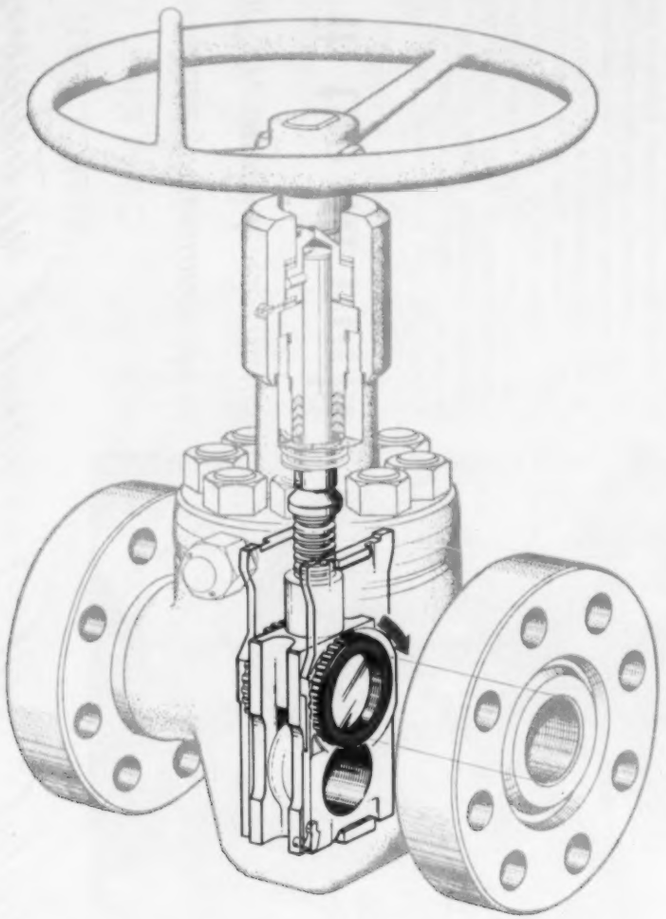

VALVE COST CLUE

The maze of costs connected with the average valve for API service requires more than a clue for a clear understanding, but here is one salient fact applicable to all.

Any API valve serves only one purpose – to open and close the line. The actual cost of the valve is the cost per operating cycle during its useable life multiplied by the number of times it is operated. For a true picture, the average operating cycle cost must include purchase price, all maintenance and repair.

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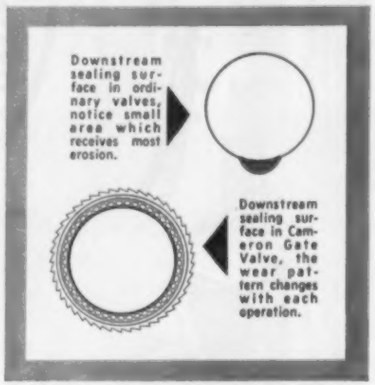
Downstream sealing surface in ordinary valves, notice small area which receives most erosion.
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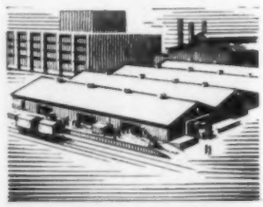

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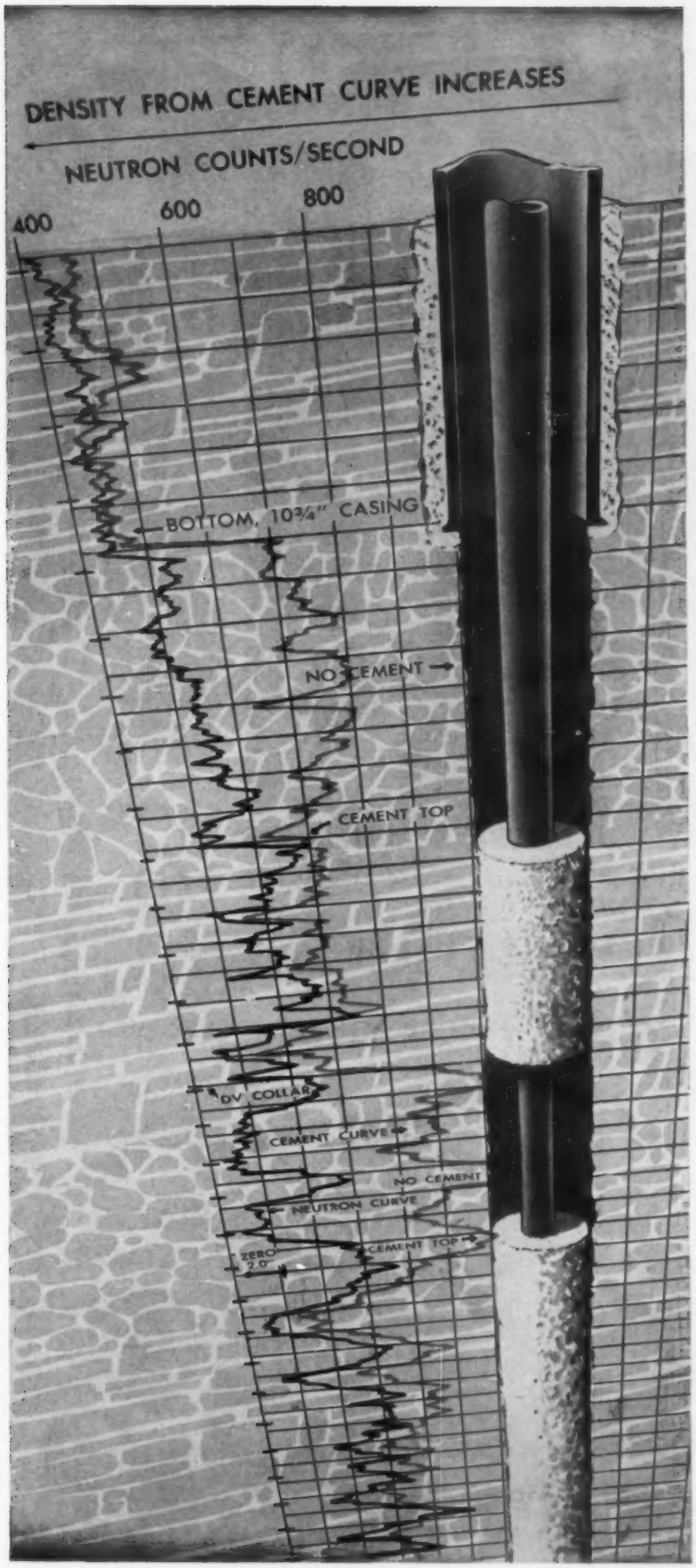

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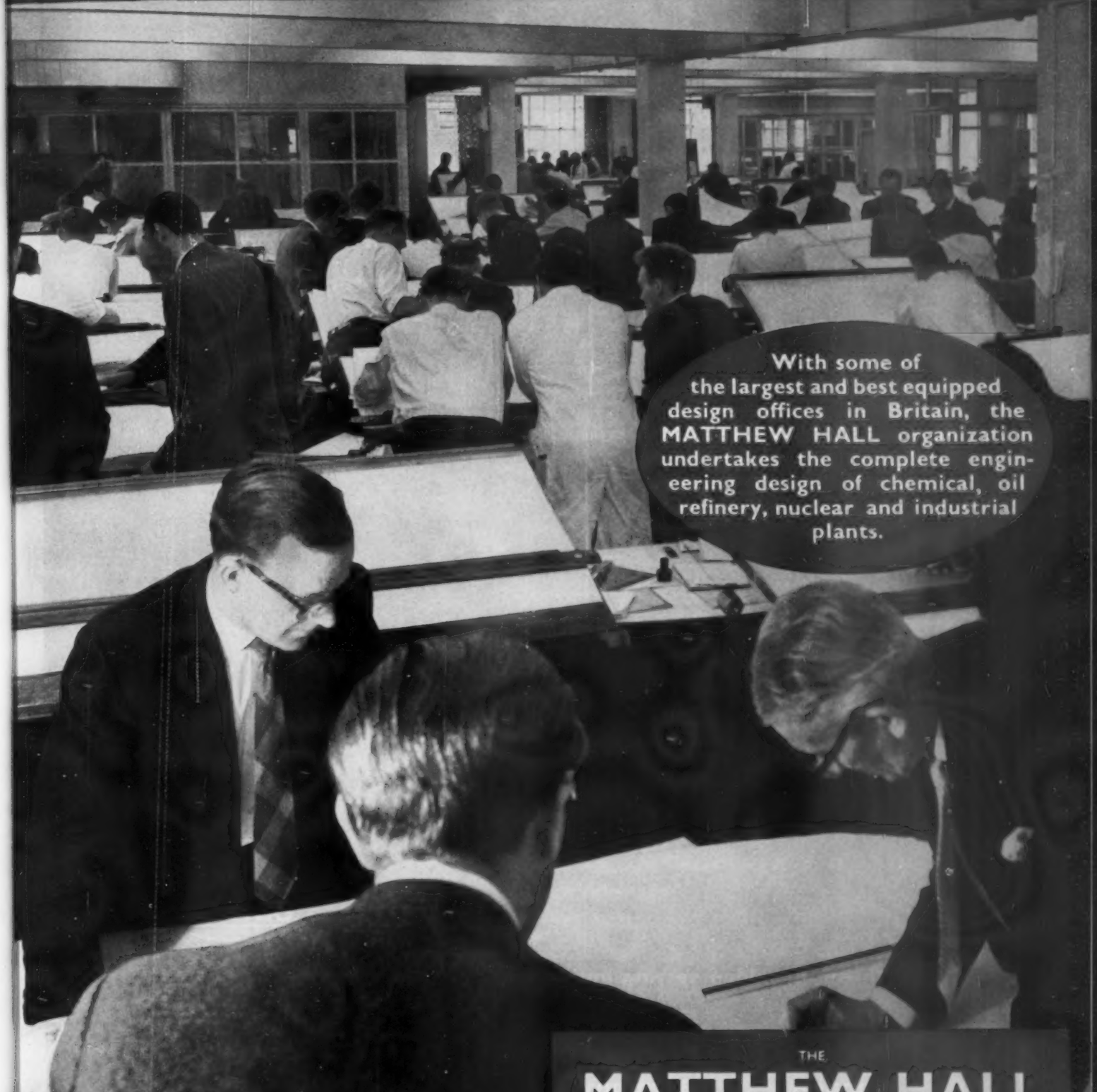

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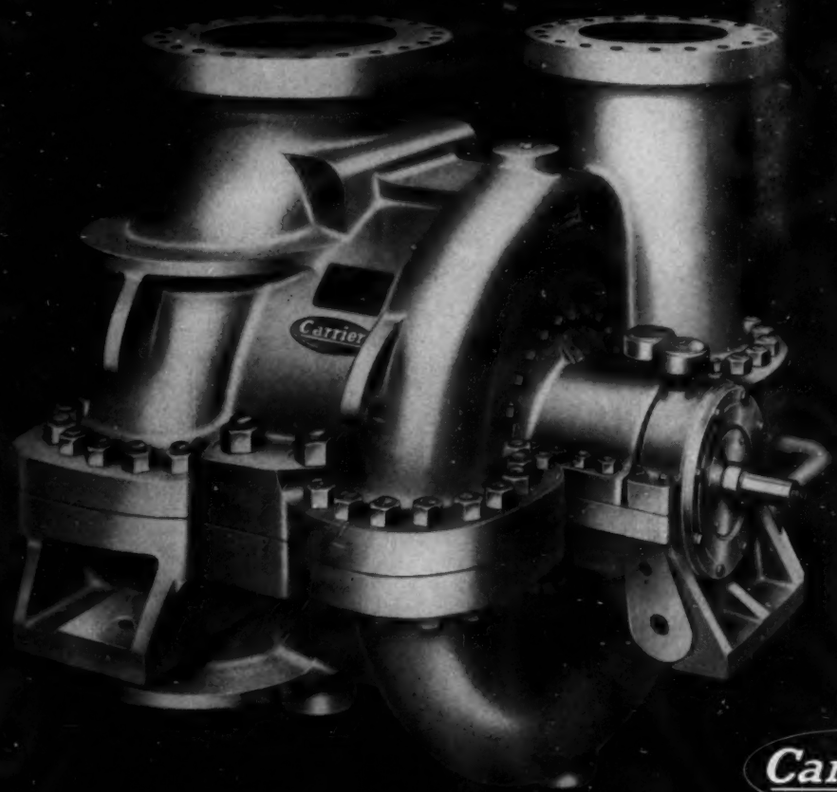

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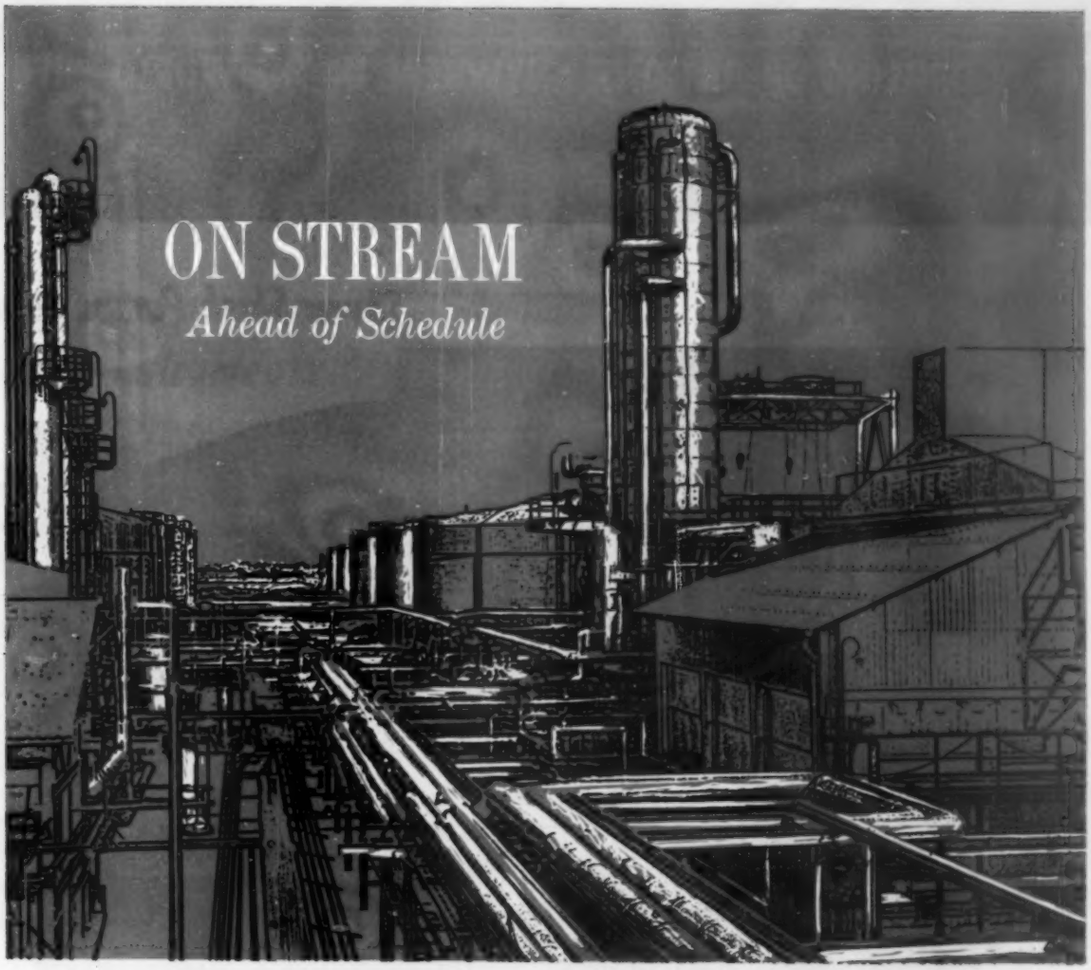

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Mid-Continent Emsco Slush Pump

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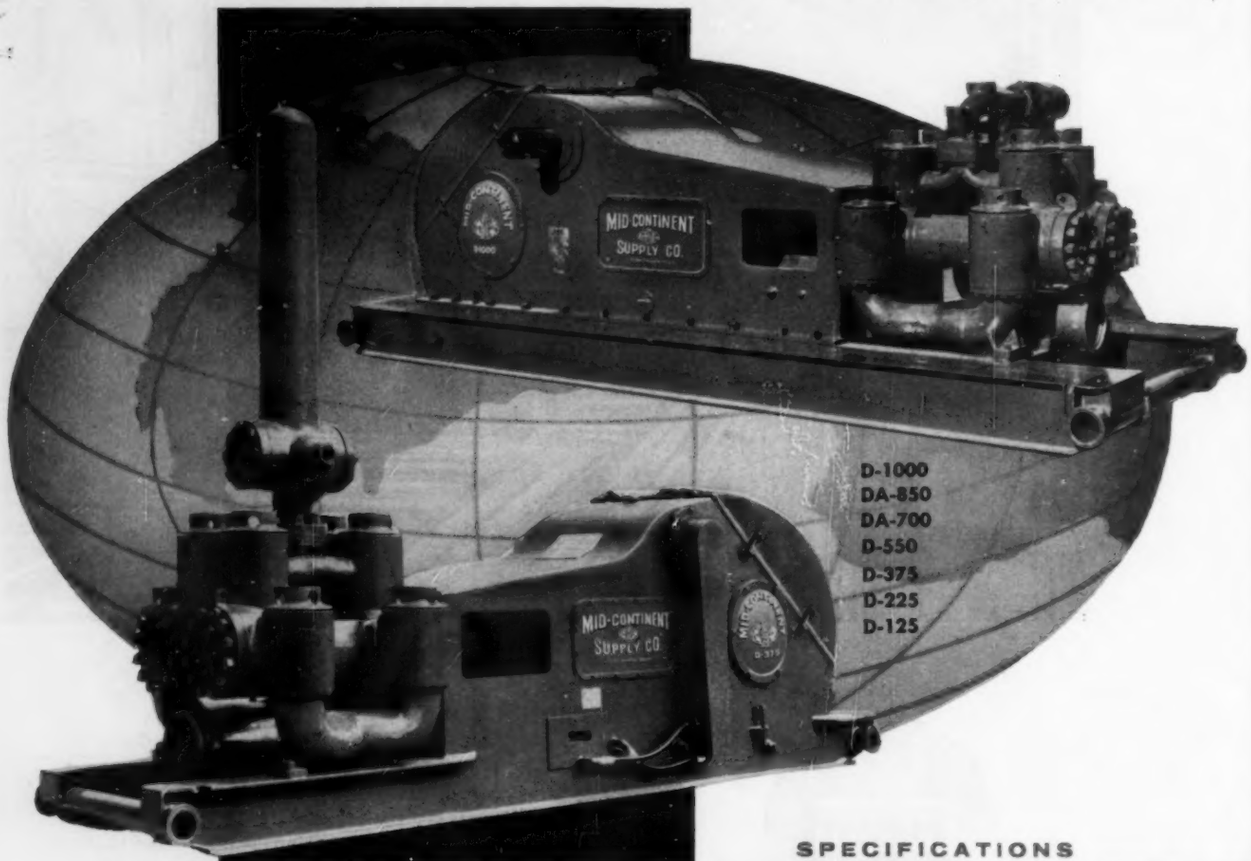

SPECIFICATIONS

	D-125	D-225	D-375	D-550
Maximum Liner Size by Stroke	7¼" x 10"	7¼" x 12"	7½" x 14"	7½" x 16"
Piston Rod—Diameter and Taper	1¾"—3 API	1⅞"—4 API	2"—4 API	2½"—5 API
Fluid End Test Pressure	3500 psi	3500 psi	6000 psi	6000 psi
Suction Manifold	8" Female	8" Female	10" Male	10" Male
Discharge Manifold	3" Female	3" Female	4" Female	4" Female
Gear Ratio	4.96:1	5.43:1	5.04:1	5.04:1
Gear Face	5"	9"	11¼"	13"
Pinion Shaft Extension (Clear)	9½"	9¾"	12⅛"	15⅝"
Bearing	Roller	Roller	Roller	Roller
Keyway	1" x ½"	1" x 1¼"	1½" x ¾"	1½" x ¾"
Eccentric Drive Bearings	Roller	Roller	Roller	Roller
Main Shaft Bearings	Self Align	Self Align	Self Align	Self Align
Crosshead Bearings	Double Needle Roller	Double Needle Roller	Double Needle Roller	Double Needle Roller
Length—Overall	11'—2"	12'—6"	14'—8"	16'—8"
Width				
Overall— Inc. Shaft Ext.	4'—½"	4'—1½"	4'—8"	6'—8¼"
Fluid End	3'—8½"	3'—8½"	4'—1"	4'—6½"
Power End—Inc. Shaft Ext.	4'—½"	4'—1½"	4'—4¹⁵⁄₁₆"	6'—5"
Skid	3'—3½"	3'—7⅝"	3'—6⅝"	6'
Height—Less Air Chamber	3'—9"	4'—¼"	4'—9"	5'—4¾"
Approximate Weight	8,700 lbs.	13,000 lbs.	18,300 lbs.	29,000 lbs.

EXPANDING

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Pioneered by Mid-Continent Supply Co. since 1938 throughout the oil fields of the world, this line of all steel, roller bearing pumps assures fastest penetration under all types of drilling conditions. A complete range of sizes to cover minimum and maximum conditions enables the user to select a pump to meet the exact job . . . expertly designed for light-weight, easy maintenance, durability and dependability. And Mid-Continent backs these pumps with fast, dependable field service from strategically located parts and service centers.

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MID-CONTINENT — SUPERMARKET FOR THE OIL INDUSTRY

PERFORMANCE DATA

Strokes Per Min.	Max. B.H.P. Input	Operating Data	LINER SIZE										
D-1000			8¼"	8"	7¾"	7½"	7¼"	7"	6¾"	6½"	6¼"	6"	5¾"
60	1000	G P M Output	933	874	817	760	703	653	603	553	507	460	419
50	833	G P M Output	778	728	680	633	586	543	502	461	423	383	349
40	667	G P M Output	623	582	544	506	470	436	402	369	338	306	279
		Gallons per Revolution	15.56	14.57	13.59	12.66	11.75	10.89	10.05	9.23	8.45	7.71	6.99
		Max. Disch. Pressure	1562	1668	1782	1917	2080	2239	2416	2638	2871	3158	3480
DA-850			8¼"	8"	7¾"	7½"	7¼"	7"	6¾"	6½"	6¼"	6"	5¾"
60	850	G P M Output	933	874	817	760	703	653	603	553	507	460	419
50	708	G P M Output	778	728	680	633	586	543	502	461	423	383	349
40	567	G P M Output	623	582	544	506	470	436	402	369	338	306	279
		Gallons per Revolution	15.56	14.57	13.59	12.66	11.75	10.89	10.05	9.23	8.45	7.71	6.99
		Max. Disch. Pressure	1329	1418	1515	1629	1768	1903	2053	2240	2440	2684	2964
DA-700			8¼"	8"	7¾"	7½"	7¼"	7"	6¾"	6½"	6¼"	6"	5¾"	5½"
65	700	G P M Output	909	852	796	743	690	640	591	544	498	450	414	374
55	592	G P M Output	768	721	674	628	584	541	500	460	422	386	350	317
45	485	G P M Output	630	589	551	514	477	443	409	377	346	316	287	259
		Gallons per Revolution	13.99	13.10	12.25	11.43	10.61	9.84	9.09	8.37	7.68	7.03	6.37	5.76
		Max. Disch. Pressure	1130	1197	1261	1374	1478	1593	1736	1875	2044	2236	2465	2727
D-550			7½"	7¼"	7"	6¾"	6½"	6¼"	6"	5¾"	5½"	5¼"	5"	4¾"
65	550	G P M Output	751	699	646	600	553	509	464	423	383	349	309	273
55	466	G P M Output	636	592	549	508	468	430	393	358	325	293	260	229
45	381	G P M Output	520	484	449	415	383	352	321	292	266	239	214	190
		Gallons per Revolution	11.56	10.76	9.98	9.23	8.51	7.82	7.14	6.51	5.90	5.32	4.76	4.23
		Max. Disch. Pressure	1067	1148	1235	1330	1443	1577	1727	1894	2090	2317	2589	2918
D-375			7½"	7¼"	7"	6¾"	6½"	6¼"	6"	5¾"	5½"	5¼"	5"	4¾"
70	375	G P M Output	723	674	626	581	536	494	473	414	375	341	307	274
60	321	G P M Output	620	577	537	498	460	423	405	355	323	293	263	235
45	241	G P M Output	465	433	403	373	345	318	303	266	242	219	197	176
		Gallons per Revolution	10.329	9.626	8.948	8.294	7.663	7.056	6.743	5.913	5.378	4.867	4.379	3.913
		Max. Disch. Pressure	744	810	871	939	1018	1104	1186	1319	1481	1660	1777	1991
D-225			7¼"	7"	6¾"	6½"	6¼"	6"	5¾"	5½"	5¼"	5"	4¾"	4½"
70	225	G P M Output	580	539	500	462	426	391	357	325	295	265	237	211
60	193	G P M Output	497	462	429	396	365	335	306	279	252	227	203	180
45	145	G P M Output	373	347	321	297	274	251	229	209	189	171	153	136
		Gallons per Revolution	8.293	7.708	7.142	6.602	6.083	5.580	5.104	4.648	4.208	3.790	3.393	3.015
		Max. Disch. Pressure	565	607	654	709	769	828	918	1007	1111	1234	1379	1551
D-125			7¼"	7"	6¾"	6½"	6¼"	6"	5¾"	5½"	5¼"	5"	4¾"	4½"
85	125	G P M Output	580	537	500	471	434	399	365	332	301	271	243	216
70	103	G P M Output	486	450	416	388	357	329	300	273	249	223	200	178
55	81	G P M Output	382	361	329	306	281	258	236	215	196	176	157	140
		Gallons per Revolution	6.949	6.456	5.988	5.539	5.104	4.685	4.288	3.908	3.540	3.192	2.860	2.548
		Max. Disch. Pressure	308	330	357	386	419	456	499	548	604	670	748	840

DA-700	DA-850	D-1000
8¼" x 16"	8¼" x 18"	8¼" x 18"
2¾"—6 API	3"—6 API	3"—6 API
6000 psi	6000 psi	6000 psi
10" Male	12" Male	12" Male
4" Female	4" Female	4" Female
5.05:1	5.03:1	4.76:1
14"	16"	18"
14"	15"	15"
Roller	Roller	Roller
1¾" x ¾" Roller	1¾" x ¾" Roller	1¾" x ¾" Roller
Self Align	Self Align	Self Align
Double Needle Roller	Double Needle Roller	Double Needle Roller
18'—4½"	20'—2"	20'—2"
7'	8'	8'
4'—8½"	6'—6"	6'—6"
6'—7½"	6'—4¼"	6'—4¾"
7'	8'	8'
6'	6'—4½"	6'—6"
37,500 lbs.	48,800 lbs.	50,500 lbs.

SP2-0

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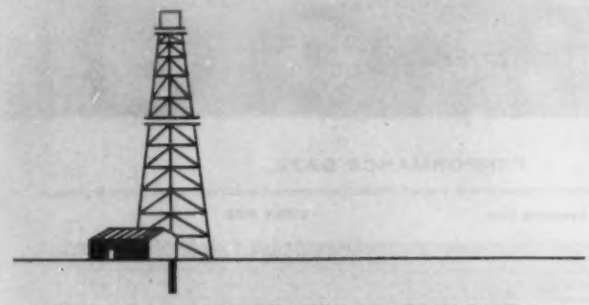

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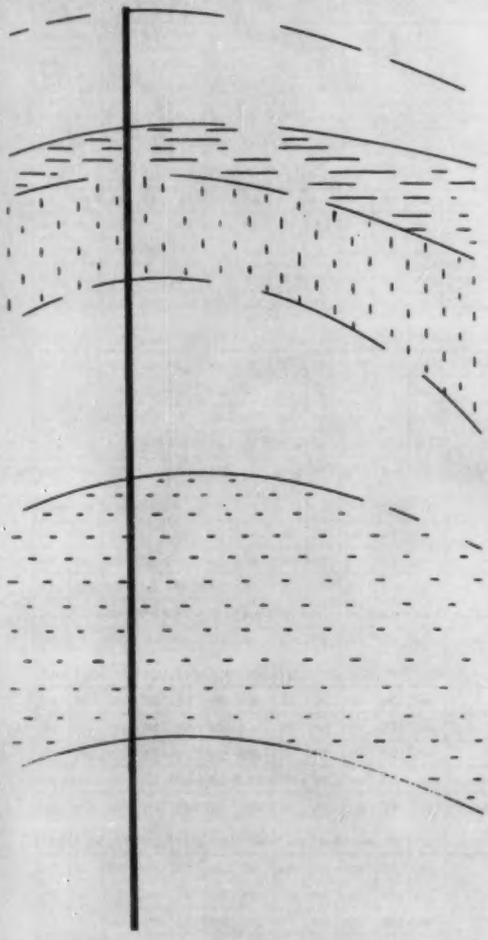

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WORLD'S LEADING DEVELOPER OF CONE-TYPE ROCK BITS

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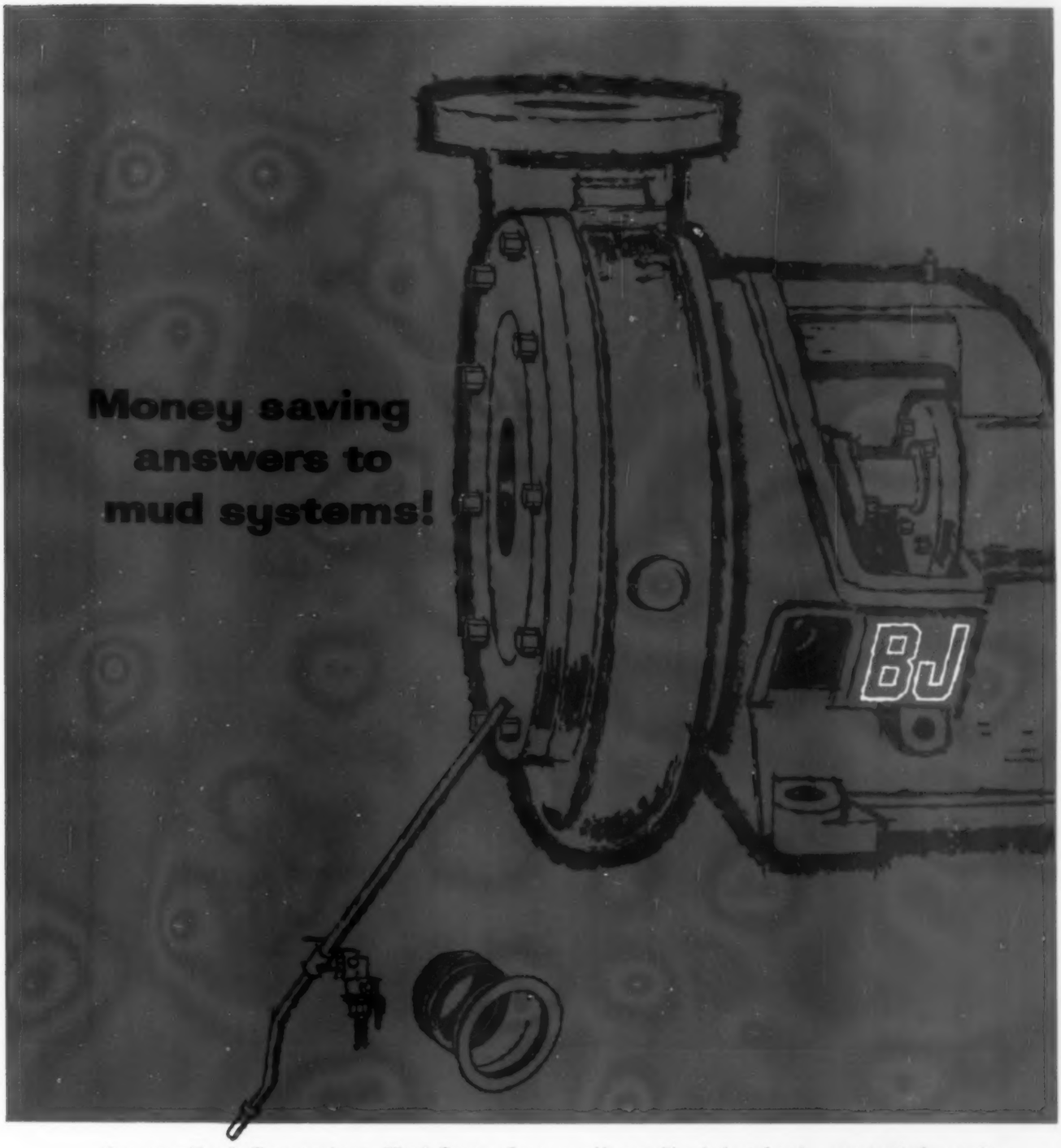
HUGHES TOOL COMPANY *ORIGINATOR AND WORLD'S LEADING DEVELOPER OF CONE-TYPE ROCK BITS*



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Marketing is the key

M. J. Rathbone

Today, with surplus capacity in producing and refining, the marketer has become the fair-haired boy to whom the other branches of the business are turning for salvation. It is time—or maybe past time—to take a careful, realistic look at marketing policies and marketing practices.

First, I want to comment on the fallacy of the notion that additional volume will always produce additional profits. Very clearly, what is needed is a different set of yardsticks of performance for the marketing end of the business. In my opinion, every one of these should have at its root a direct and demonstrable relationship to profit. The test of profit or loss should be applied to every marketing organization as a whole and to each part of it. I am convinced, however, that until this is done, we will continue to contribute to the magnitude and duration of the problems which plague our industry. Businessmen are in business to make a profit—aren't marketers businessmen?

Let me turn now to another area where I think action is necessary. I'm referring to finding ways to expand demand for oil products. Here is certainly a field in which marketers should take the lead, and I'm glad to see that some work—such as API's travel program—is now under way to stimulate the consumption of gasoline and oil. We should not overlook opportunities to find *brand new* uses for oil products. Jersey Standard started a program of this sort in 1956 and my only regret is that it wasn't done sooner.

First, we have been doing a good deal of work on new uses in the field of agriculture. One of these involves spraying a film of asphalt over the soil right after seeding in semi-arid areas. This technique can make almost worthless land useful for agriculture. World-wide, only a very limited use of this discovery could lead to an increase in the use of asphalt ranging up to 100 million barrels a year.

Another new use centers around the substitution of fuel oil or gas for coal or coke in the metallurgical industry. We now know this will work, and our research people are planning full-scale tests in cooperation with two leading steel companies.

The hydrocarbon fuel cell is another project which shows promise. The use of oil for air-conditioners, water heaters, dryers and other household uses is another field of study which appears promising.

I might also add that I think we should make a real effort to find new ways to merchandise gasoline. We need some bold, imaginative thinking along these lines. Other industries have found new ways to attract and provide service for their customers. Even banking—traditionally a conservative business—has adopted new techniques. Why can't we?

My third observation today has to do with the silent and invisible, but very senior, partners we have at each service station in the country. You may recognize these partners as the state and federal tax collectors. I'm sure everyone here is familiar with the imaginative action recently taken by the dealers in Virginia to post prices exclusive of taxes and thereby make their customers aware of the heavy tax burden levied on gasoline. I certainly want to commend all the people who had a part in planning and carrying out this move.

Before turning to my final suggestion I want to say a word about dealers. Every day there are about twelve million gasoline purchases made at service stations across the country. Who makes all these contacts with the public? Usually it's the poorest trained member of the oil industry — the attendant. He's the dealer's biggest problem—and he's our problem, as well. We should give a lot more thought to dealer recruitment, selection, and training.

Conditions in our industry are such that we can well heed the advice which was given to a woman who was applying for credit at a bank. She had furnished most of the information called for in the application form but was hesitating a long time in deciding just what to fill in in the blank space marked "Age." After watching this silent struggle, the Credit Manager finally leaned over and said to her, "Madam, the longer you wait, the worse it gets."

M. J. Rathbone

President Standard Oil Co. (New Jersey) and Chairman, American Petroleum Institute

US oil experts in the electromodelling laboratory of oil-bearing deposits, All-Union Research Institute of Oil and Gas

Russian oil— through American eyes

U. S. PERSONNEL ON USSR OIL TRIP

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Department of Interior

Alex Gakner
Bureau of Mines
Department of Interior

TEN MEMBERS of the United States petroleum industry visited the Soviet Union's oil industry recently under the auspices of the API and U. S. State Department. They traveled some 7,350 miles throughout Russia, from August 2nd through August 30th. In all, about 69 hours were spent in active productive work, including some 10 days in the field, and five days of conferences. Of the total on the job about half was non-productive due to the need for interpreters. Nevertheless, the program gave them certain definite impressions, summarized in this article.

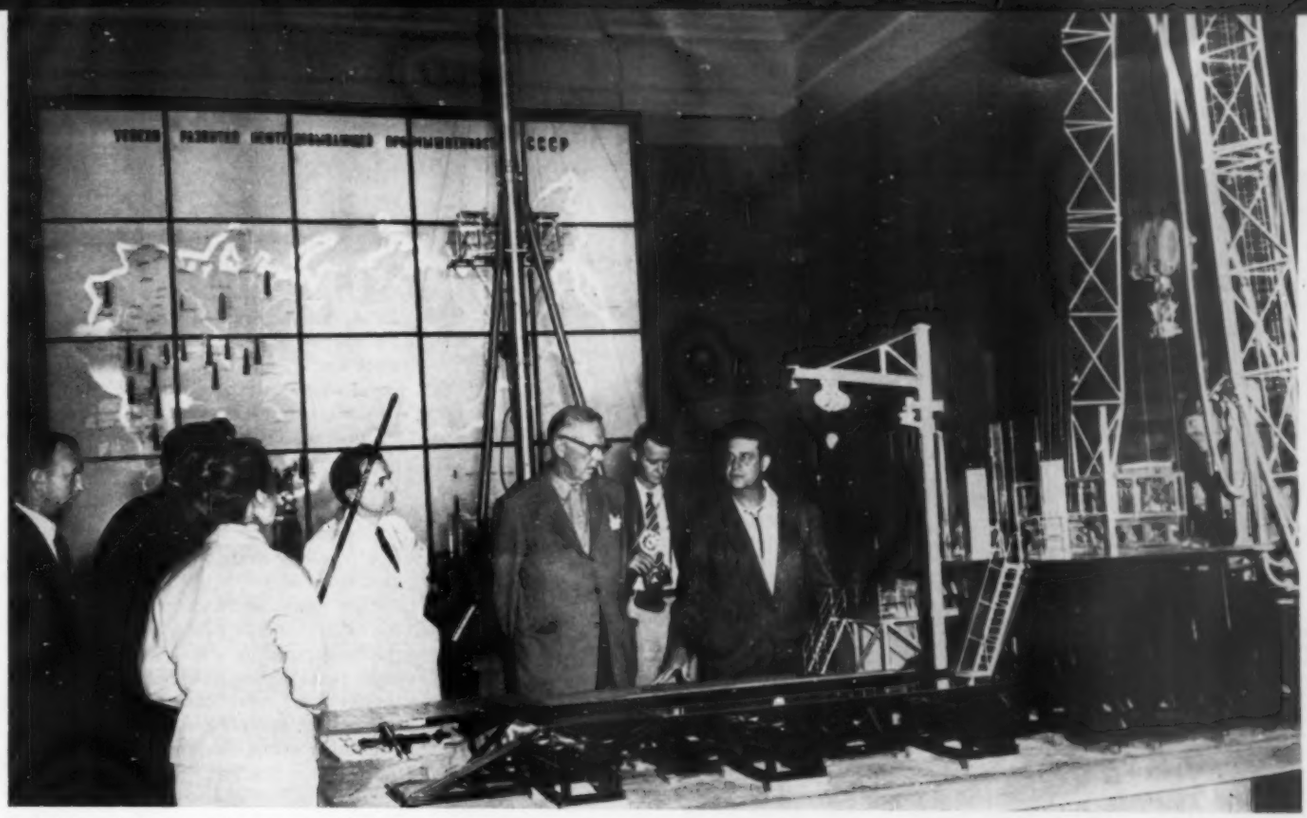
Most of the trip was spent in inspection of refining and oil field facilities, including drilling. Four refineries were visited, located in Ufa (Ural-Volga region), Novobakinskiy (Baku), Syzran (Down Volga from Kuibyshev) and Novo-Kuibyshev (Ural-Volga region).

Oil fields visited were Tuymaza-Octyabrsk (Ural-Volga region), Karadag (Baku region—gas distillate), Artyom (Baku region offshore), and Zhirnovsk (North of Stalingrad).

Institutes, committees and councils visited included the State Scientific and Technical Committee (Moscow), Institute Giproneftezavod (Refinery design) (Moscow), All Union Scientific and Research Institute (Oil development) (Moscow), Scientific Research Institute, (Ufa), Gosplan, (Moscow), Regional Economic Council, (Stalingrad), and Sojuznefteexport (Moscow).

The Soviets cooperated better than anticipated, but some were better informed than others, and some were more evasive.

None of the program was dedicated to exploration, reserves, gas, transportation, petrochemicals, and the manufacture of equipment. Some information was obtained on organization and the working of



US visitors look at model of oil drilling installation at Pavilion "Oil, Gas", USSR Economic Achievements Exhibition

Russia's oil industry is young—but growing fast. Although technically a decade behind the U. S., the lag means little for their technical skill is adequate to their needs at present. Soviet oil finders are looking for oil with modern techniques in a lush area that resembles the United States in 1929—but twice as large.

their economic system, although costs were trade secrets.

Exploration. The basic exploration area available to the Soviets is very large. Petroliferous territory that could contain oil covers about three million square miles, over double the entire likely hunting ground in the United States. Even if all of Alaska and Western Canada are added it is still about 14% larger. Much of this vast territory is unexplored. Only about 50,000 wells have been drilled, compared with about 1.6 million wells in the United States. If the two areas' ultimate reserves are about the same, in the neighborhood of 200 billion, the Soviets have produced only about 6% of their oil. The USA has already produced over 31% (62.9 billion barrels) of its ultimate reserve. So the Soviet geologist has the advantage of a perpetual lease on 1.944 billion acres, just starting on its productive career. Comparing the two countries, the Soviet Union is about where the USA was in 1929. But it is starting at that 1929 level with 1960 oil tools in geophysical, drilling, logging and geology. That makes a difference, and makes the job much easier.

Among the new fields that have been found are several found by drilling structures apparent on the surface. Among these are the Tuymaza-Octyabrsk and Zhirnovsk. Other fields have been found in the Ural-Volga area by seismic work, although technical difficulties in this area make it difficult to use. It also makes the smaller fields difficult to find in this area, as the Russians recognize. They are doing geophysical work in the new Karadag field, and continue to find fields in the old Baku area. Offshore Russian geophysics are surely adequate to finding good prospects, although the Artyom field offshore may only be an extension of the onshore Artyom field.

ITINERARY
U. S. VISIT TO SOVIET OIL INDUSTRY
AUGUST, 1960

Aug.

2 Arrive Moscow.

3 Meeting with State Scientific and Technical Committee on itinerary; sightseeing.

4 Exposition; cocktails at U. S. Embassy.

5 Giproneft (Refinery Design Institute).

6 All Union Scientific and Research Institute for Oil Development.

7 Sightseeing in Moscow.

8 Arrive Ufa by plane.

9 Scientific Research Institute.

10 Refinery; night train to Oktyabrsk.

11 Tuymaza-Oktyabrsk oil fields, night train to Ufa.

12 Arrive Moscow by plane.

13 Gosplan.

14 Arrive Baku by plane.

15 Novobakinskiy refinery; offshore movie.

16 Karadag oil field.

17 Artyom oil field.

18 Arrive Stalingrad by plane.

19 Arrive Zhirnovsk by plane; Zhirnovsk oil field.

20 Arrive Stalingrad by plane; Regional Economic Council.

21 Sightseeing in and around Stalingrad.

22 Arrive Kuibyshev by plane; Hydrofoil to Syzran refinery; Hydrofoil back to Kuibyshev; car to Novo-Kuibyshev.

23 Novo-Kuibyshev refinery.

24 Arrive Leningrad by plane.

25 Sightseeing; conference on preparation of report of trip.

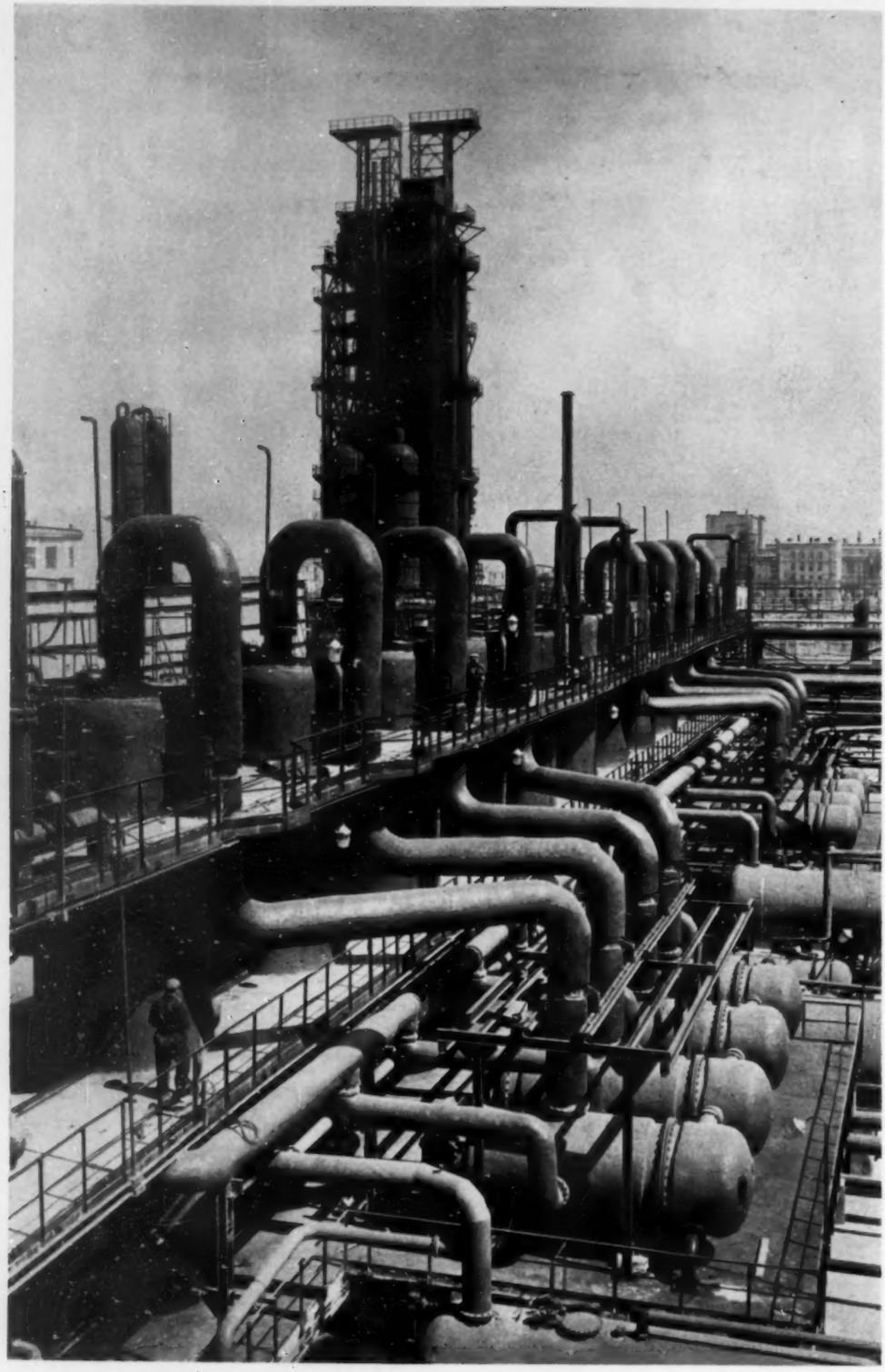
26 Sightseeing.

27 Production and refining conferences on preparation of report; sightseeing.

28 Arrive Moscow by jet; shopping.

29 Report to State Scientific and Technical Committee.

30 Arrive Brussels by plane.



Chemical plant in Sumgait, Azerbaijan, Sovfoto

Soviet work is wide-spread, as well. Considerable geophysical work, about 38%, was done in Siberia during the 1955-1957 period. In 1958 they operated 447 seismograph crews and hope to have 1,200 operating in 1965. This compared with 422 seismograph crews working in the US during 1958. Other geophysical and geochemical methods are widely used. In 1958 they operated 338 such crews, compared with 56 in the United States.

The old specter of failure and exile no longer haunts Soviet oil men—at least not to the extent it used to. They have learned that wildcat wells must be drilled to find oil and that many must inevitably be dry. Wildcat drilling in unexplored areas is going on to learn the geologic section. Subsurface mapping of fields is used as well, and technicians are equal to the task.

Production. Soviet production of crude oil is increasing rapidly. Plans call for 4,-800,000 b/d in 1965, more than six times 1950 production. Gas production at the same time is projected at 14.5 billion cubic feet per day, about 26 times 1950 rates. This would put them, in 1965, on a level roughly comparable with the United States in early 1945. The increase in Soviet production would be as much in the five year period of 1960 to 1965 as it was in the United States in seventeen years 1929 to 1946.

Low cost is paramount in Soviet production planning, and they try to balance local and national needs. Development drilling is high grade, drilling the best fields first, which is good planning. Drilling and production operations could be improved, perhaps because the lush fields and lack of problems do not push producers to cut capital and operating costs.

Drilling operations are making extensive use of the turbodrill, which is particularly appropriate to the hard rock areas of the Ural-Volga region, where in some fields it is superior to the rotary rig. While operations do not appear to equal American efficiency, by improving equipment and reducing excess equipment which increases moving costs the Soviets could improve and approach American levels.

The general impression is of too many people, and too much equipment. Much of the excess personnel was explained as a means of training. Personnel could be greatly reduced, no doubt, and production increased by use of improved piping, faster workovers and improved gas lift operations, gas drive and waterflood. Safety requirements are generally much lower.

The Russians do not appear to be producing fields at more than maximum efficient rates, despite pressure for higher levels. Conservation is kept in mind and the production job is technically pretty good.

About 23 oil and 10 gas areas are found in the general area west of the Urals and around the Caspian. Discoveries have spread to Siberia, east of the Urals where one oil discovery and at least two gas finds have been made. Oil fields in Sakhalin island are still producing as well.

Research into new production methods is done with competent people. Equipment is poor by U. S. standards, although it compares more favorably with equipment in Western Europe. The American team saw only applied research operations, which included such lines as calculation of reserves, electric models, stimulation of production, drilling muds, core analysis, utilization of casing head gas, bottom hole analysis, material balance, paraffin deposits, gas condensate production, analysis of clays, logging methods, drilling methods, water flooding, treating of injection water, gas drive, hydrofrac, acidization, flow through porous media, well spacing optimums and the like. There is considerable multiplicity of lab-

oratories and this should foster independent thinking and improve over-all research.

Reserves. Although the American team did not receive any figures on proved reserves they did, however, get some clues.

The Russians compute both recoverable (proved) and geological reserves, but their method results in a larger current figure for recoverable reserves than in the U. S. When a field is found they cross section it with step out wells (called exploratory) defining the water level, productive area, acre-feet, and amount of recoverable oil before starting the development program. U. S. figures start out with a small figure and through the years raise or lower it as drilling progresses and production history is obtained. The Russians revise their figures to a lesser extent. Also, these "exploratory" wells improve their exploratory well success average greatly. They increased the amount of exploratory footage to the point that it exceeded development footage in 1958 and 1959. The Soviets recognize that their exploratory statistics and ours cannot be compared accurately and are considering the adoption of the U. S. system, but think that on the U. S. basis their success average in exploration is better than that of the U. S.

The oil expert of the State Economic Council, Maksimovich, stated that they produce their wells at the average rate of 4% of the proved reserves per year. At Stalingrad 4% was used for the larger fields and 10% for the smaller. They further stated at Stalingrad that the minimum permitted ratio of proved reserves to production of either oil or gas is eighteen years, but they strive for twenty-five years or 4% per year. The U. S. rule of thumb is that sustained production of 100,000 b/d requires a reserve of 500 million barrels or 7.3% per year or 13.7 years. With their higher reserve figures computed as described above, they naturally arrive at a higher figure for the years of reserves at present rates of production than U. S. figures do. This does not mean their approach is wrong; in fact, it should be a more accurate method than that of the U. S.

Taking Russian 1960 production of 2,880,000 b/d (1.047 billion annually) their reserves may be: assuming 25 year life—26.2 billion barrels; 21.5 year life—22.5 billion barrels; 18 year life—18.8 billion barrels; 13.7 year life—14.4 billion barrels.

It so happens that the figure of 22.5 billion barrels (3.1 billion tons) is close to the figure of over 3 billion tons ventured by one of the Soviets in a rapid fire discussion.

Such reserve figures are somewhat meaningless in appraising the potentialties of the Soviets. It is of far more importance to observe that the Soviet Union has adequate "hunting grounds" and has demonstrated its ability to find, develop and produce oil and gas in increasing quantities.

Refining. The first U. S. team's impression of Soviet refineries was one of extravagance—too many people, too many units, too small and too far apart, and too many control rooms. Of course, the figures given may be inaccurate or not understood, but assuming reasonable accuracy, total personnel in the four refineries amounted to almost 18 people per thousand barrels of daily capacity—almost twice U. S. averages. The large personnel was justified on the basis of training for the large expansion ahead. They are planning larger stills and more compact refineries. Safety standards are also less exacting than ours. Among other things the underground pipe trenches are hazardous in case of fire. Apparently, however, they are satisfied with their safety practices, relying on the record in this respect. The delegation saw no catalytic reforming but was advised that such exists in the Soviet Union and that more is under construction or planned.

The problem of refiners in the U.S.A. is to maximize gasoline and to meet competition by improving the quality of every product. The Soviet's problem is to maximize the production of diesel fuels but because of the absence of competition the quality of diesel and other products need not be higher than "practical." Nevertheless, they are making better products than they used to and plan to make still better ones and more of them. They probably know most of the tricks necessary to such upgrading. In this connection they have demonstrated their ingenuity in copying equipment and processes developed elsewhere. They must know that if they try to enter world commerce on a large scale, they will have to improve quality in order to be competitive.

Refining Research. The U. S. team saw no refining research. However, in the meeting with Giproneft they heard about a refinery research unit with some branches and employing 2,500 people including 900 engineers, 200 of whom have advance degrees.

Transportation And Storage. Storage facilities are obviously inadequate in the Soviet Union, a fact which they readily admit. During the seven-year plan they plan to build almost 19,000 miles of oil trunk lines, 40% of which will be product lines. By the end of the seven years they hope that all refineries will be supplied by pipe lines and that the big consuming areas will be supplied by product pipe lines. Rail and water transportation will be used for the smaller markets. Gas trunk lines in excess of 16,000 miles and up to 40 inches in diameter are also planned.

Costs. The U. S. team was told the first day in Moscow that costs would not be revealed, but that did not prevent it from being inquisitive. The extravagant use of people, equipment and space has been mentioned. Salary and wage bills are certainly not as excessive as statistics seem to indicate because Russians make less money. Even with accurate information on costs of people in those particular facilities, however, we still know little of over-all costs, such as costs of materials, equipment, space, or construction. The present seven-year plan (1959-1965), furnishes some clues, however.

Exploration And Production Costs. Finding and development costs must be reasonable. During the period of 1950-1958 when the U. S. drilled 1.655 billion feet of hole, over 402,000 wells averaging 4,113 feet in depth including almost 110,000 exploratory wells in the U.S.A., the Soviets drilled, according to reports, only 142.6 million feet of hole, a little less than 28,000 wells averaging 5,140 feet in depth including less than 12,000 exploratory wells. Putting it another way the U. S. drilled approximately 11.6 times as many feet, 14.5 times more wells, 18.2 times as many development wells and 9.4 times as many exploratory wells.

In the United States during this period, according to API estimates, 24.2 billion barrels of crude were added together with another 7.3 billion barrels of crude equivalent (20 mcf of gas plus natural gas liquids equals one barrel of crude)—a total of 31.5 billion barrels or approximately 19 barrels per foot drilled. Judging by the Soviets' increase in production of oil and gas during the period, they must have added some 15 billion barrels of crude and equivalent, or 105 barrels per foot drilled.

The seven-year plan envisages capital expenditures of about $20 billion in the production end of the business (exclusive of housing, hospitals, etc.), $14 billion on drilling alone (1 ruble—25 cents). Assuming that they include the same items in capital expenditures we do and assuming that total additions to reserves will be the equivalent of 33.4 billion barrels (twenty-year life, 27.8 billion barrels of crude, 5.5 billion barrels of crude equivalent, 20 mcf gas—one barrel crude), finding and developing capital costs of 60 cents a barrel are indicated, drilling alone accounting for 42 cents. In the United States in recent years capital costs of finding and developing exclusive of lease bonuses are around 85 cents per barrel of crude and equivalent. According to the seven-year plan 260.8 million feet of hole will be drilled in the Soviet Union or 128 barrels of crude and equivalent per foot drilled. The suggested increase in barrels per foot drilled over the previous seven-year period is in line with their claim that they are steadily reducing costs.

The limit of error in such calculations is obviously large. If, for instance, the true value of the ruble is 10 cents, finding and developing capital costs are 24 cents per barrel instead of 60 cents as suggested above. Perhaps it is a fair guess that no matter how one slices it, their capital cost per barrel of proved reserve is much lower than in the U.S.A.

The team obtained no information on predrilling exploratory costs. Their tendency to "overscience" projects probably increases Soviet costs. The Soviets do far more core drilling and exploration geophysics than in U. S. However, they do not buy leases and pay rentals, and the staggering cost of these items in the United States (50 to 60% of predrilling exploratory capital and expense) will pay for more extravagance than they probably indulge in. In the United States in recent years predrilling capital investment and expenses have been in the neighborhood of 40 cents per barrel of crude and equivalent found and devel-

oped. Assuming that Soviet geology, core drilling and geophysics are 60% of such costs, rather than 40%, the Soviet predrilling exploratory bill must be in the neighborhood of 25 cents per barrel, or 10 cents on the basis of 10 cent rubles.

Judging by the sample the team saw, producing (lifting) costs have to be higher than in the U. S. Some U. S. companies produce four times as many barrels per man on the job (exclusive of the headquarters staff) as they do. It is very doubtful if the salary and wage bill can be four times as large per man in the U.S.A. using available statistics. With lifting costs in the United States being between 50 and 60 cents per barrel of crude and equivalent, Soviet costs must be, say, 80 cents.

All this adds up to a possible cost of $1.65 per barrel (finding, developing and lifting) using 25 cent rubles, which would be very reasonable to low in the United States but which is excessive by Middle East standards. However, if the real value of a ruble is only 10 cents, such costs are only 66 cents and very low even by Middle East standards. As already mentioned, the limit of error in such calculations is substantial. Also one must wonder how much higher the costs may be when overhead is included.

Refining Costs. Soviet refining costs (exclusive of cost of crude) are probably closer to U. S. levels. The team was told that a little over 15,000 people were working in the refineries visited and that a 120,000 b/d plant employs, on the average 1,800 people. If their average income is $5,100 per year, as was suggested, the salary and wage bill amounts to about 25 cents per barrel of crude capacity. This is not out of line with such costs in the United States. According to the seven-year plan refining capacity will be increased almost 2 million barrels per day at a cost of almost $14 billion (exclusive of housing, hospitals, etc.). Compared with capital costs in the United States these Soviet costs appear to be in the ball park. The Soviet system of pricing crude and products remains a mystery.

Soviet Drive & Competitive Spirit. To one raised in the American system of free, competitive enterprise, it is hard to believe that the Soviet planned economy can work very well—or last very long. It is even harder for the Soviet to believe that the U. S. can make its daily bread without national planning of every facet of life. He has been steeped in this system for 40 years and before that the Czars ruled with an iron hand. The Soviet simply goes to a different economic church. Of course, there must be different degrees of devotion to the faith; the spectrum of degrees of devotion must be about like those in the U. S. Even if they would talk, they give the impression that most of them would be hard to proselyte. Imagine a Christian convincing a Moslem that only he has a chance to enter the pearly gates!

What makes the Soviet tick? First and foremost, he is dedicated to the system of a planned economy. This creeps out in any serious conversation even though the system is not being discussed specifically. Then he is dedicated to the proposition that he must produce more and more—it is unthinkable to produce less. All over the country one sees charts in various institutions and publications with the lines always pointing upward to that 1965 goal. Of immense importance is the Soviet's dedication to the potency of science and engineering. More and more scientists and engineers are being trained. More and more of these well-educated people are being promoted into management. He is no less dedicated to the education of everybody else. There are trade schools where they are taught to be competent mechanics, repairmen or what not. Apparently the goal is an educated nation with each man and woman trained to the limit of capabilities. And, believe it or not, they are dedicated to competition — not competition among industries and units within industries but competition among themselves. Do a better job than the other fellow and you'll be rewarded — perhaps with a medal but certainly with a raise in pay or even a promotion. Individually and collectively they do have drive. It is a bitter pill to be forced to admit that in the oil business, at least, their system is working pretty well—too well.

Competition. With their resources, accomplishments and drive, they can be pretty tough competition when they set their minds to enter the international oil trade. In 1955, they became a net exporter of petroleum and last year net exports amounted to 419,000 b/d, of which 109,000 b/d of crude and 158,900 b/d of products went to the free world. The 1965 goal suggests an exportable surplus of 520,000 b/d of crude alone, more than double 1959 net exports of crude. Here they would be capitalizing on a gift from heaven—a gift that supplies them with cheaper fuel than their poor coal does as well as the other products necessary to a modern industrial society and very useful in foreign trade.

Today, petroleum is supplying about 25% and gas about 6% of the Soviet Union's energy requirements. That's about where the U.S.A. was in 1929. Today petroleum supplies 42% and gas 30% of U. S. energy, and the U. S. consumes over 2½ times as much energy per capita from all sources as the Soviets do. Coal is being replaced by oil and gas rapidly, the Soviets say, and civilian consumption is skyrocketing. Unquestionably, the Soviets are moving in the U. S. direction in the matter of consumption of petroleum and gas. They visualize a vast country with vast demand and deny that they would penalize home consumption in order to expand exports. Nevertheless, they also admit that they must balance domestic requirements with expanding economic opportunities outside the Soviet Union and point out that certain deals of undisclosed magnitude have been made to supply satellites and that long-term (3-5 years) arrangements have been concluded with certain countries in the free world. They feel that they are just as entitled to a share of the world's export market of crude as any country of the free world. A terminal has been built at Klaipeda on the Baltic Sea for export to the free world. It will be supplied by pipe line. Another pipe line is projected to Odessa on the Black Sea, and pipe lines are planned into the satellite countries.

The Soviets are preparing for greater export to both the free world and satellite countries. Are they going to concentrate on trading their oil for foreign exchange which they need, or for much needed products they do not produce; or are they going to concentrate on creating economic and political mischief by unsettling the world markets?

It is well at this point to attempt to assess their competitive position. The population of their western satellites is almost 98 million. Consumption of products in 1958 was reported as a little over 200,000 b/d. Crude production of these satellites in 1959 was a little over 260,000 b/d, and net imports of crude and products were about 75,000 b/d. Seemingly, here is a large potential market, and deals have been made to deliver crude (and products) by pipe line from the Soviet Union. China with a population in excess of 640 million imported from the U.S.S.R. in 1959 only about 61,000 b/d, mostly products. The Soviets have no plans for pipe lines into China. Ignoring China, the potential market in the western satellite countries alone is still very substantial.

By 1965 demand in the free countries of Europe, Asia, Africa and Oceania is expected to increase between 35 and 40% to as much as 9 million b/d. These areas are the "natural" markets for Soviet crude and products. Here, however, they lock horns with crude from the Middle East and North Africa and products from more modern refineries.

Clearly, however, the Soviets are more competitive in Northern Europe than elsewhere. If their true cost is only $.66 per barrel (10 cent rubles), they are extremely competitive costwise even at Bombay where their profit on Baku crude at "posted prices" would be $.47. If it is true, as rumored, that they have offered crude f.o.b. Black Sea at $1.13 per barrel, they could even make some $.15 per barrel profit on Baku crude.

It is, of course, obvious that if they value their crude for trading purposes as though it had been produced at a cost of $.66 per barrel, or at any rate much lower than $1.65, they can raise havoc in world markets. This they can do when the chief executive is a politician first and foremost. There is a shortage of diesel in the Soviet Union—yet they are exporting it. At least some of their decisions must be politically inspired. It makes one a little uncomfortable that such powers rest in the hands of a chief executive of a country with such tremendous possibilities to produce. Oil men would be well advised to prepare for a ding dong trade battle with this tough competitor who may play a little rough.

END

Communications in the API

Increased use of regional meetings has stimulated flow of useful information available through the American Petroleum Institute. The site of regional conferences can be rotated to various areas for the convenience of those attending

One of the American Petroleum Institute's principal functions is to disseminate information throughout the industry. Apart from the annual meeting, which some claim has grown too big to effect exchange of all information, there are many regional meetings and their effect has been increasingly to spread information in the more highly specialized fields. The various API divisions have gone about it in somewhat different ways, as the following summary of activities of the Production, Transportation, and Refining Divisions shows.

Transportation Division — The Division of Transportation came into being on January 1, 1946. In the beginning, the greater bulk of divisional committee work was accomplished at the API annual meeting; however, it soon became apparent that time limitations made desirable additional meetings of the various central committees. Therefore, the central Committee on Radio Facilities (now called the Central Committee on Communication Facilities) held its first mid-year conference in 1948. The Central Committee on Pipe Line Transportation took this course of action in 1950, followed by the Central Committee on Transportation by Water, who both sponsored their first mid-year conferences in 1956.

These conferences allowed key personnel of the petroleum transportation industry to meet more than once a year; offered an opportunity of more time to conduct business meetings; provided an excellent program of technical papers if desired; allowed for field trips of interest; and afforded an opportunity for local oil transportation employees to attend.

The mid-year conferences of the Highway, Pipe Line, and Water Committees are held in various locations throughout the United States, while the Communications Committee members meet in Washington, D. C. The Highway and Communications Conferences are primarily open business meetings with an occasional paper on a subject of importance to the attendees, while the Pipe Line and Water meetings usually include a wide range of general information papers and excellent technical symposia. Each of these conferences generally is scheduled for three days.

The mid-year conferences have produced effective results, as indicated by the trend of increasing attendance each year and by their very good acceptance by industry. They have provided a medium through which the committee members have been able to deal more effectively with their problems by meeting twice a year. They have fostered excellent relationships with the attendees' foreign counterparts and government officials, both of whom have regularly participated in the meetings.

By meeting in different cities each year, participation in the conference has been made possible for many who would not normally attend the API Annual Meeting. The technical papers presented at these meetings have had wide acceptance and have been published in whole or part in many trade publications.

It is believed that these mid-year conferences of the Division of Transportation have brought about greater understanding, cooperation, and the advancement of technical information among those concerned with oil transportation.

Refining Division—The Division of Refining does not conduct regional meetings. It reduced the number of technical sessions held at the annual meetings of API at the beginning of 1946 to two, and no more than two technical sessions have been held at the annual meetings by the Division of Refining since that time.

The Division agreed to concentrate its technical session at a midyear meeting, customarily held in May of each year. The location of these national midyear meetings is rotated in an orderly progression through the Gulf Coast, Eastern Midwest and Pacific Coast areas, with an occasional digression to Canada. This procedure has met with the approval of the refiners, as evidenced by the growth of the programs of the midyear meetings of the Division of Refining during the last fifteen years.

The rotation of the location of the meetings gives an opportunity for technical men, who are not normally privileged to journey long distances to technical meetings, to attend the Division of Refining meeting once every four or five years. All signs indicate that refiners find this conducive to wider dissemination of technical information and increasing interest on the part of technical personnel.

Production Division—On March 8 at Shreveport, La., the API's division of production will launch its 1961 series of annual district meetings. This Southern district meeting will be followed by five others in various parts of the country. The six meetings will have an attendance of around 4,000 drilling and production managers and technical people from large, medium and small companies.

An API district meeting is open to attendance and participation by the industry at large. Membership in the institute or affiliation with its committees is not in any way a requisite to participation in a district meeting. Many of the most productive officers and committeemen obtained their first insight and interest as a casual observer at a district meeting.

A diversity in program material and committee agenda sufficient to attract a variety of professions is necessary. While operational and research managers, supervisors and engineers are in the majority there is inevitably good attendance by industrial relations, training and safety directors, crude purchasers, land and geological people, bankers, service and supply company representatives and many other occupations.

Division of the country into districts and rotation of the meetings among the production centers of each district permits concentration on problems that are peculiar to the district and to the locality in which the meeting is held. No monetary value can be placed on the considerable part of the industry's technical and operating literature that has been provided by the API. The essence of committee discussions, and of papers and reports evolving from them, is the repeated sharing with the industry of the knowledge gained at great cost and effort by one company. The process helps each company to avoid needless duplication of experimentation done by others, and suggests new and profitable practices and the refinement of old ones. The pooling of data frequently makes apparent that which could never be discerned from the information held by any single company. END

A submarine 16-inch pipeline is shown being laid to Aramco's Safaniya Field, now producing nearly 160,000 b/d. The Neutral Zone offshore areas lie above, where Japanese interests have discovered a major field rumored to be over the billion barrel mark. Bids have been submitted on the Kuwait offshore area, which also has excellent prospects.

World oil conservation — the Arab view

by Abdullah Hamud Al-Tariki

In September a symposium of industry leaders presented their views on international prorationing and the current world oil surplus. In this article a government official intimately concerned with the idea and one of its first proponents states his view.

Abdullah Hamud Al-Tariki is Director General of Petroleum and Mineral Affairs for the Kingdom of Saudi Arabia. He was born in Zilfi, Najd Province of Saudi Arabia, on March 19, 1919. He received his Bachelor of Science degree in geology from Cairo University in 1945, and his M.A. in petroleum geology from Texas University in 1947. From 1947 to 1948 he underwent a special training program with Texas Oil Co. From 1948 to 1954 he was head of the inspection office, Bureau of Mines, in Saudi Arabia. In 1954 he became Director General of Petroleum and Mineral Affairs.

Major exporting areas that would be affected by a world prorationing scheme. New areas in North Africa are soon to come into production and may make agreement on the division of world markets more difficult.

THE OIL INDUSTRY is changing the basic economies and the way of life for the peoples of the Middle Eastern countries, and the governments themselves are becoming more dependent upon the oil industry for their revenues. These changes are resulting in the development of industrial economies in place of agrarian economies.

The importance of petroleum is shown by the following estimated percentages of oil revenues to governments' incomes: Iran, 1959—27%; Iraq, 1958—47%; Saudi Arabia, 1958-59—81%; and Venezuela, 1959—60%.

It is obvious that the economies of the net exporting countries are substantially and critically dependent on the petroleum industry. It is also obvious that price fluctuations in the market can easily upset the delicate balance between the governments' incomes and budget expenditures as is illustrated by the losses in income (shown in the following table) sustained by the Middle East countries as a result in the reduction of posted prices in February 1959 by only 10%:

Country	Loss
Iran	$27,000,000
Iraq	24,000,000
Kuwait	46,000,000
Saudi Arabia	35,000,000

The necessity for finding a method of stabilizing the economies of the Middle East oil exporting countries caused the concept of proration on an international basis to be first developed. It was recognized that with productive capacity far exceeding demand, conditions existed for the development of destructive competition in the form of "dumping" or price wars, which could result in disaster for the exporting countries. Such a condition would be intolerable today, for the consequence would be both serious and far reaching.

In view of experience in the United States, the prevention of over-production today logically points to proration, in this instance on an international instead of a state or national basis. There are no concealed motives behind the concept of international proration, and its objectives can be simply stated, as follows:

1. *The stabilization of markets* by the prevention of production in excess of the market demand.

2. *The prevention of "economic waste"* caused by the unnatural depression of prices resulting from over-production.

3. *The conservation of an irreplaceable natural resource* for the benefit of the particular countries and for future generations.

It is quite natural that the most controversial point in the proration plan will undoubtedly be the stabilization of the markets, or if you will, the control of prices. In my concept of international proration, it is the prevention of the unnatural and unnecessary depression of prices due to overproduction that is to be prevented; it is not the purpose to develop monopolistic control of the market for making indiscriminate price increases. Actually there will be no monopoly because the domestic petroleum industries of many importing nations will continue to be a potent force in the determination of the price structure. It is my sincere belief that all exported oil should supplement—not supplant—the importing nations' domestic oil industry. In other words, imported oil should come into an importing country only when needed, and then only at a competitive price.

The abuse of international proration will be restrained by the existence of tremendous reserves of shale oil, the development of nuclear energy, or by any other type of energy which may be economic.

The initial step towards international proration of oil will be, of course, agreement between the interested countries on the principle and subsequently on method of execution. Such an agreement would be limited to those countries whose exports exceed their imports, or in other words to "net exporting" countries. This requirement will limit participation to only those countries whose direct interests are involved, and will also make for a more workable organization by limiting the number of participants.

Once agreement in principle has been reached between the net exporting countries (i.e., countries whose exports exceed their imports), the development of an equitable proration formula should not present any particular difficulties. Such a formula could be developed by competent technical personnel, who would certainly take into consideration these factors:

1. *The proven reserves of each country.* This would be the basic factor in any formula, and uniform methods of reserve estimation would be used.

2. *The encouragement of good conservation practices by the participants.* The control and operation of a participating country's fields will remain an internal matter, but the commission should act in an advisory capacity on conservation matters and encourage good practices by all known means.

3. *A provision for future discoveries,* either within a participating country or in few oil producing countries when they become eligible to participate.

4. *A correction factor for the participants' current market position.* This factor would prevent any undue loss of revenues during the early stages of proration. However, the future increases in demand would be allocated in such a way as to eliminate or minimize this consideration.

Any such formula would necessarily require constant revision of the various elements to be maintained on a current status. Provisions would also be necessary for possible exceptions made necessary or desirable by conditions which may develop in the future.

The administration of an international proration plan would logically be the function of a commission or committee formed for the purpose. Such a body could conceivably consist of two divisions; first a policy making group composed of representatives from each of the participating countries; and secondly, an administrative group composed of permanent employees. The first group would formulate the high-level and operational policies, consider all problems of a policy nature, and exercise general direction of the administrative division. The latter group would consist of the necessary supervisory, technical, administrative and clerical personnel for the execution of the proration agreement. A commission so organized should be able effectively to carry out the program. END

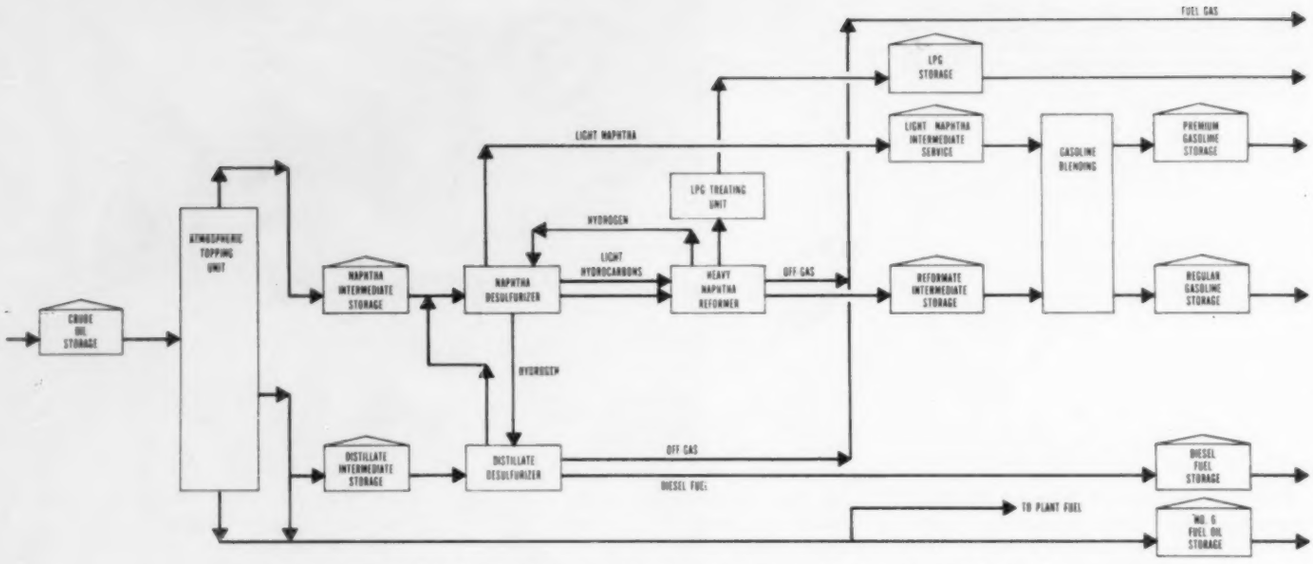


Fig. 1—Schematic block diagram illustrates principal process flow at new Emden refinery of Frisia A.G.

Frisia enters manufacturing with new 30,000 b/d refinery at Emden

ANOTHER NEW "GRASS-ROOTS" refinery went on-stream in West Germany this fall when Frisia Erdoelwerke A. G. completed its $18 million, 30,000 b/d refinery at Emden. This marked the entry of another marketing company into its own manufacturing operations, and has raised total refining capacity in West Germany to 671,500 b/d.

Finished three months ahead of schedule, the new Frisia plant received its first delivery of crude oil by tanker from the Kuwait Neutral Zone late in August. Formal dedication ceremonies were held September 24.

The refinery site, at Larrelter Polder near Emden, is approximately two miles from the North Sea, at the northwest tip of West Germany and close to Netherlands. Ralph M. Parsons Co., engineers and constructors of Los Angeles, carried out process design, engineering, procurement, construction, and start-up.

Principal units of the refinery include an atmospheric crude distillation unit, a distillate desulfurizer, a naptha desulfurizer and reformer, product blending, steam and utility plant, crude and products tanks, barge and shiploading wharves, and tank car and tank truck loading racks.

Sales products are premium and regular grade gasolines, 4,436 b/sd total; liquefied petroleum gas, 549 b/sd; diesel fuel, 4,000 b/sd; and varying grades of fuel oil, 20,925 b/sd. The ratio of premium to regular grade motor fuel will be adjusted in accordance with market conditions. Premium gasoline ratings will range from 96 to 98 octane.

The refinery has been designed to process a 50-50 blend of ratawi and eocene crudes from the Neutral Zone, but with sufficient flexibility to process 100% eocene crudes. Process flow, shown in the block diagram in Fig. 1, is conventional.

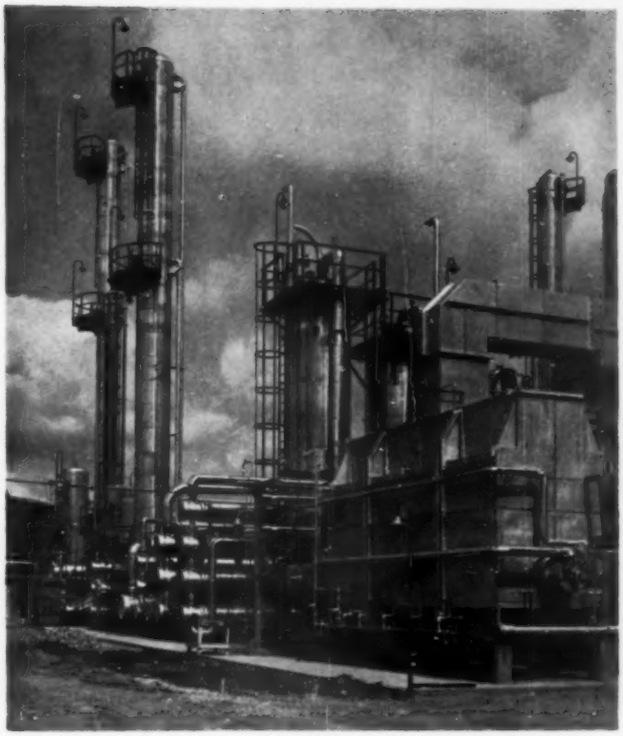
The crude unit is a 30,000 b/sd atmospheric column with box type heaters, sour water stripper, and electrolytic desalter. Overhead naptha flows through intermediate tankage to the single-reactor, 5,600 b/sd naphtha desulfurizer and reformer. This unit includes a three-reactor, 4,000 b/sd nonregenerative type catalytic reformer, recycle compressor, naphtha splitter, reformate stabilizer, de-ethanizer column, LPG caustic and water wash drums, and an LPG drier. Light overhead naphtha from the desulfurizer and the reformate flow to gasoline blending facilities. Reformer offgas goes to the refinery fuel gas system.

Middle distillate from the crude column flows to the 4,200 b/sd distillate desulfurizer, a single-reactor unit with a package type box heater, recycle compressor, and a diesel stripper column. Desulfurized product goes to diesel fuel sales; off-gas to refinery fuel gas.

The steam and utility plant consists of three package type, 30,000 lb/hr, 175 psig steam boilers with accessory equipment—water softener, deaerator, instrument and plant air compressor, instrument air drier, 50-kw emergency electric generator, and condensate storage tank—all housed in a steel frame building.

Other general offsite facilities include an LPG bottling plant, octane knock-test engine building, tetraethyl lead blending system, and a four-cell, 10,000 gpm capacity cooling tower with chemical treatment of cooling water.

As a public relations measure, and to



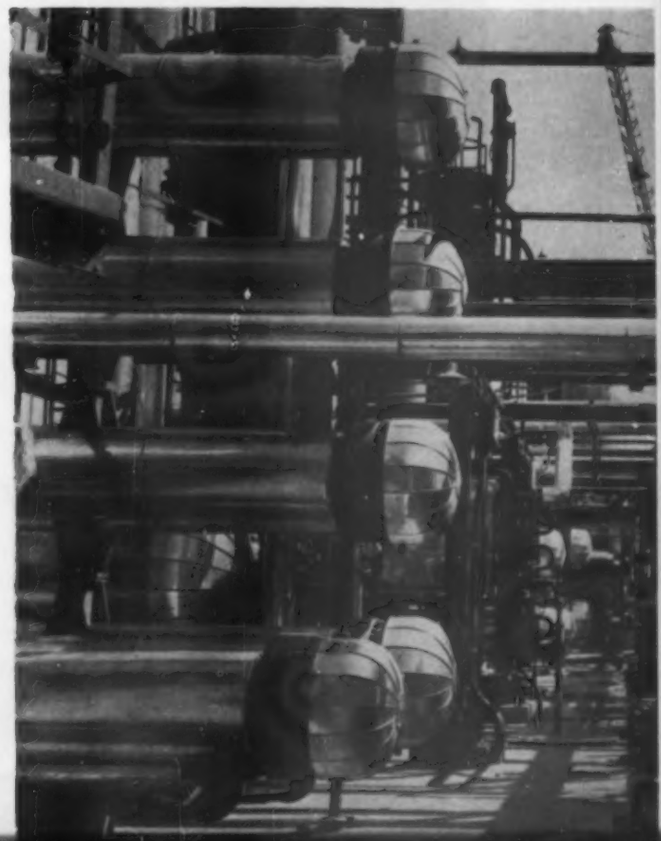
Naphtha desulfurizer and catalytic reformer section of Emden refinery

General view of Frisia's new refinery at Emden, 30,000-b/sd crude still and heater to right of pipeway, crude storage in background

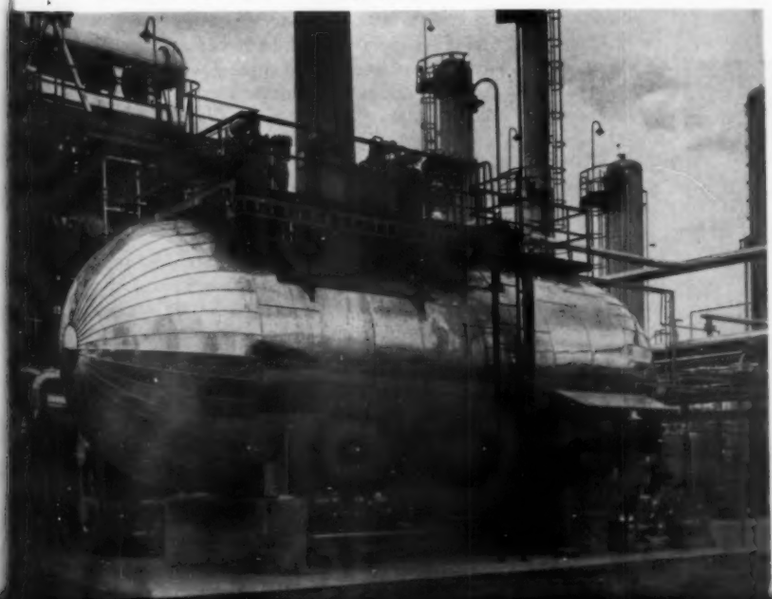
comply with new anti-pollution laws, many precautions were taken to make the plant a good neighbor for the people of Emden. The tankage for volatile materials has been vapor-proofed either by floating roofs or by floating aluminum blankets. There are six floating roof crude oil storage tanks, and 23 fixed roof product tanks and spheres, some with the floating blankets.

The liquid effluent treating system is quite elaborate and consists of a primary oily water separator, clarifier, skim pond, flocculator, sludge drying beds, and a two-mile

Bank of heat exchangers for the reformer



Crude desalting unit at Frisia's refinery



Left: Tanker wharf in Emden harbor, with loading and unloading facilities

pipeline for the disposal of the treated effluent. A combination flare stack and blowdown drum prevents atmospheric pollution from gaseous materials.

Wharf facilities, comprising two barge wharfs for product loading and one tanker wharf for crude unloading and fuel oil loading, are connected to the refinery by a two-mile pipeline system. The lines make one shallow and one 1,300-ft deepwater crossing of the Emden harbor. They consist of one 26-in. crude and fuel oil line, two 10-in. fuel oil lines, three 6-in. diesel and gasoline lines.

The Emden site was chosen as the most advantageous for the export of heavy fuel and heating oils, which do not have as ready a market locally as the gasoline and LPG. It was with this in mind that Frisia and Parsons constructed the wharf equipment for both barge and tanker.

At the refinery location, poor soil conditions required extensive use of foundation tie beams to provide proper strength. The plant is built upon land that was reclaimed from the sea, land beyond the dike.

Major buildings on the site in addition to the process units include administration and laboratory, change house, knock-test unit, TEL blending, control house, fire station and garage, maintenance shop, warehouse, and the LPG bottling plant.

Frisia is the first public-owned independent refinery in Germany. The company was founded in 1957 by Gottlieb Duttweiler and a group of associates. It opened its first service station in December, 1958, and since that time, the now familiar green-and-white stations have spread from Emden to locations in Schweinfurt, Worms, Weil/Rhein, Freiberg, Alzey, and Hanover.

The Hanover service station, located at the Vahrenwalder Strasse, has been a success since it opened. Its location at the town entrance and the super highway exit, helped call the attention of many visitors to the Hanover Fair to the company and its products.

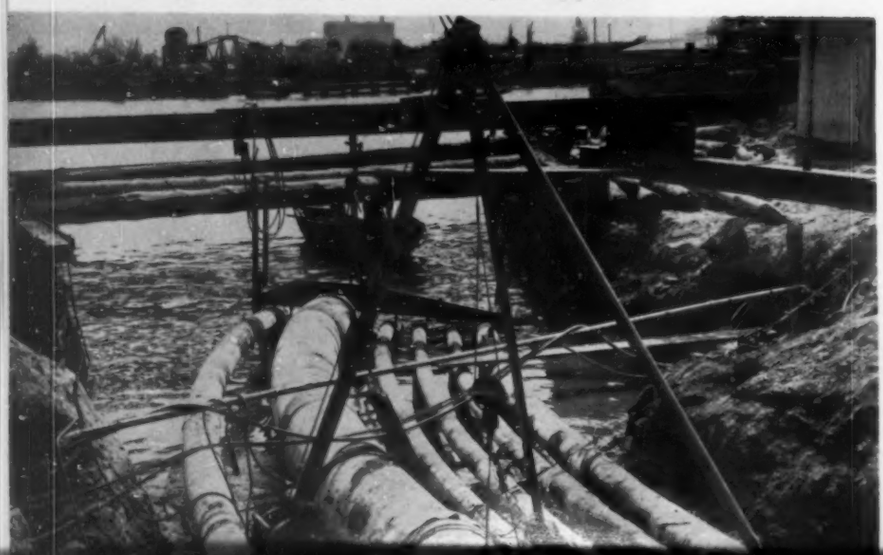
Until the new Emden refinery went into operation, the company obtained motor fuel from the Swiss Migrol Co., a product of not less than 93 octane. Frisia is going to sign contracts with 200 service station owners for the supply of its 96 to 98 octane "Superfrisia" gasoline. The company will sell only to its stations and not wholesale to large consumers.

Frisia A. G.'s DM 25 million shares at 6% are presently held by 27,000 shareholders, of which 19,000 are in Germany. The company said that the Emden refinery will be the first German plant to guarantee its customers that they will always receive a uniform, high quality motor fuel. This is the result of long-term contracts for the supply of crude oil from only one source, and the manufacturing in a single refinery in accordance with standardized procedures.

END

Foundation forms, showing extensive use of cross ties because of difficult soil conditions at Emden site

Underwater crossing of the crude oil and products pipelines



Automated hydraulic rig for faster deep drilling

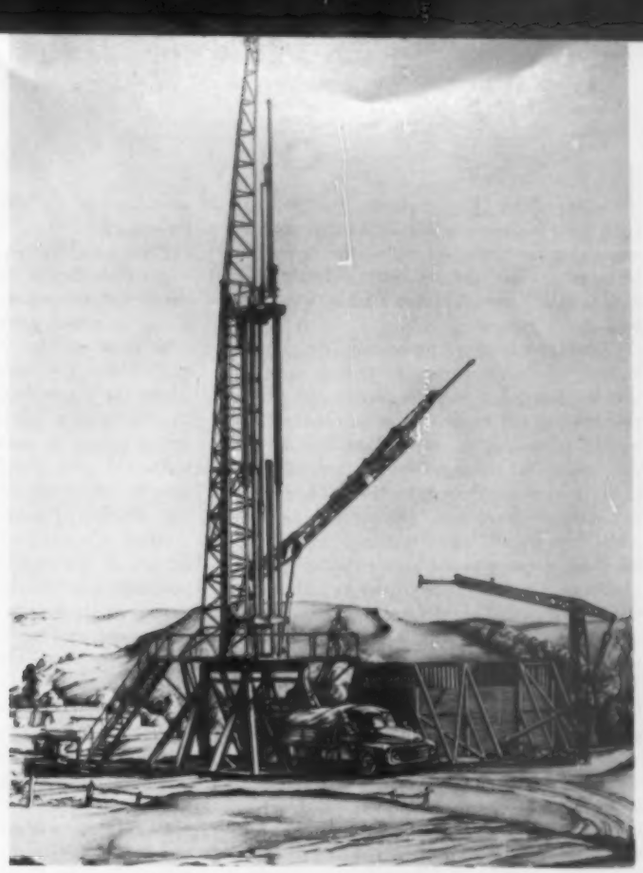


Fig. 1 Drawing shows how new automated, all-hydraulic rig would look on field location

New British-developed system promises continuous pulling, faster tripping, and smaller drilling crews

by Hew D. Fanshawe

Hew D. Fanshawe

About the author

Hew D. Fanshawe, who holds an honors degree in mechanical sciences at Cambridge University, received his early training and experience in oilfield engineering with British Petroleum Co. and later with Kuwait Oil Co. In 1953 he joined Schlumberger, and worked in Venezuela, Peru, and Pakistan before becoming a member of the company's engineering department in Paris.

The improvement of drilling equipment had increasingly come to monopolize Mr. Fanshawe's interest, however; and since 1957 his advanced ideas have been sponsored by the National Research Development Corp. and he has become associated with F.N.R.D. Ltd., London, a subsidiary of National Research.

AN AUTOMATIC, ALL-HYDRAULIC drilling rig being developed in England under the auspices of the National Research Development Corp. could provide a solution to the problem of conflicting demands for portability versus faster round trips for deep drilling.

It can change bits up to four times as fast as a conventional rig, yet is much smaller, more portable, and requires only three men per shift. It allows a round trip from 16,000 ft in less than three hours.

The rig is particularly advantageous for deep drilling. It will not be economic, nor is it designed, for shallow drilling. At greater depths (even with 1960 bits), its advantages rapidly outweigh the first cost of automation. Drilling deep enough in hardrock areas, a contractor could expect to cut his overall costs by more than 15%.

Up to now, it had been very evident that surface equipment for deep drilling was approaching the peak of development in its present form. At a time when demands for portability and faster round trips are about to become vastly more important, the practical or economic limit is being reached for every feature of the drawworks and blocks system.

By contrast, the subsurface tools and techniques of rotary drilling are developing continually in quality and variety, as fast today as at any time since 1900. Current research effort is concentrated upon penetration rate, and it is likely that in coming years bits will be developed to drill four times as fast as now, while the corresponding improvement in wearing qualities will only double footage per bit. This means that boreholes will be completed in about half the time, but also that bits will last only half as long.

Fig. 1 shows the new rig on location. It has no drawworks, blocks, or rotary table. Singles are racked horizontally by automatic transfer arms, and the string is rotated by a hydraulically-powered swivel. The power house, probably trailer-mounted, is connected to the rig and to pressure-exchange diaphragm slush pumps by fluid lines only.

Twin hydraulic lifts provide the most distinctive feature. The rig can pull and run pipe automatically and continuously, dismantling the string "on the fly."

Rig Components. The following points are noteworthy in regard to components (Figs. 1 and 2). The substructure never carries both casing and stand-back loads nor engines, so it is smaller while still providing good access to the wellhead. As to guide structure, the lower 47 ft of what looks like the mast in fact takes only lateral loads. It supports a pair of channel section guides against defection, these taking torque and random horizontal loads transmitted from the lift platform by guide-rollers which run in the channels. The upper section is a light 33-ft jib whose function is only to carry sheaves for catline and sandline. The feet of the pair of rams of the upper and lower lifts are at the diagonally opposed corners of a narrow rectangle straddling the borehole. These are ball-mounted and have 19-ft strokes. As to pipe-handling tools, slips are mounted in the rig floor and on the lower lift; there is no rotary table. For round trips, the upper lift carries elevators or slips, make-and-break mechanism, and spinning and transfer mechanism.

Pulling Pipe. The sequence for pulling each joint is shown in Fig. 3. Two processes are going on simultaneously—the string is being pulled and the top single is being disconnected. Running pipe exactly inverses both these processes.

Consider the lifting separately: the string is kept moving at a steady "pulling speed" and the lower lift (say) is accelerated from the bottom of its stroke to take over the weight of the string at "pulling speed" as the upper lift approaches the top of the guide structure. Only then does the upper lift start to decelerate. During the period while the upper lift is pulling, the lower lift stops, returns to the bottom of its stroke (midway up the guide structure), awaits the right instant, accelerates up to "pulling speed" as the lower lift closes up to it, and finally takes over the string "on the fly." The upper lift now pulls until the lower lift has returned down and is ready moving at "speed" to take over the string weight again.

This interrelation of cycles enables the entire pipe string to be pulled (and run) in one smooth continuous motion at any speed up to the design maximum of 240 ft/min, power and hole conditions permitting.

Normal variation in Range 2 pipe length is accommodated by overlapping the timing of individual lift cycles, without altering their stroke-length or motion pattern, which are exactly the same for both lifts every time.

Disconnecting the single concerns the upper lift only. The string is being gripped by it, the whole single is projecting above and moving with it, and the break-out and spinning mechanisms are mounted upon it. The loose single is lifted clear and displaced laterally as the upper lift reaches the top of its stroke, and is brought down by it to the midway station (Fig. 2; pipe position D).

Racking—During the instant that the upper lift is awaiting its next turn to pull, the loose joint is taken away by the transport arm. This swings it down into a horizontal position above the pipe-rack where it is taken by the racking arm and deposited in its appropriate slot in the rack. The rack itself has no moving parts, and could be broken down into unit transport loads, each protecting its complement of pipe.

Drilling—For drilling, the elevators are removed from the upper lift and a mud swivel, rotated by integral hydraulic motors, is slung from the same attachment points. Drilling feed is controlled by a simple needle-valve. After drilling down to midway, the power-swivel transfers to the lower lift to complete its stroke.

To add a new single, the bit is raised off bottom—it can be left on bottom if a core is being cut—and the string is gripped in slips in the rig floor. The power-swivel is then handed back to the upper lift, the lifts fully separated, and the new single introduced between them. It is on this occasion that the linkage shortens the transport arm as it swings up into place. (Fig. 2, pipe position E).

Power Supply—A group of independent units, these being engines direct-coupled to variable-delivery pumps, are manifolded together to supply pressurized hydraulic fluid. This main supply is switched to the ram-pairs alternately when pulling pipe, the demand for power being as smooth and continuous as the motion of the string. One motor pump is reserved to maneuver the unloaded lift, whichever it may be, and also to power all mechanisms. When drilling, this unit drives the power swivel.

Mud Circulation—The main hydraulic supply is directed to a pressure-exchange pumping unit. In classical form this type of pump needs only a mud-valve chest, oil-valve gear, and two or more chambers each divided by a flexible diaphragm; oil is valved to each chamber in turn, its entry expelling the mud. There is no pressure difference across the diaphragms, which merely prevent oil and mud from mixing.

Special-purpose diaphragm pumps have been made since the 1870's for their lower maintenance without pistons or rotating parts. Dowty Rotol Ltd., of Cheltenham, Glos., are now forging ahead with a diaphragm slush pump as a separate project, since novel features promise for it an independent future.

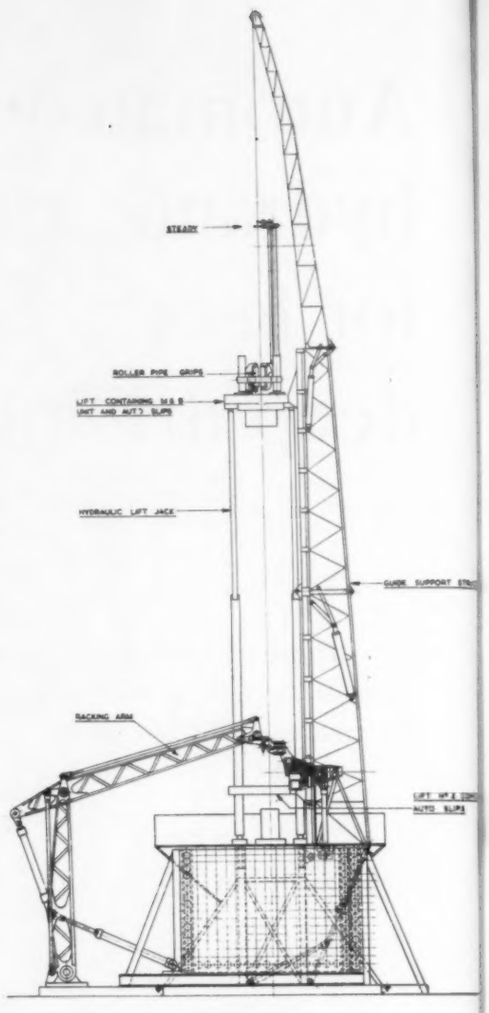
Control and Mechanism—Exceptionally delicate drilling control is provided by hydraulic rotation, needle-valve feed control, and pressure gauge torque and weight indication. With up to eight joints handled per minute manual intervention is not practicable, so for round trips the driller uses only Start and Stop buttons and an overall speed regulator. He will also have separate manual control of the selector-valves which actuate each rig mechanism—used, for instance, when running casing.

The mechanisms are mostly of one uncomplicated type. All the functions of drilling are performed by the four lift rams, 10 operating rams, and nine small gripping rams, plus the power swivel and spinning motor. The last two are the only rotating parts outside the power house. There are no chains, gearing or bolting anywhere on the rig, and conveyors and rack-and-pinion devices, usually the bane of transfer equipment, have been avoided entirely.

Maintenance costs will therefore be less than conventional for most "sizes", and capital costs less too, for the largest capacities.

Save Time or Money. Hydraulic cylinders are suited ideally to the direct lifting of heavy loads, but their use in drilling has been prevented by the short length of stroke which is practicable. The use of twin lifts overcomes this difficulty, and mounting the dismantling mechanism on the moving lift-platform removes the reason for packing pipe in stands. Rig size is related to the length of a single and time is not lost breaking joints or lowering elevators.

The continuous motion of the string provides the further time-saving which allows



normal horsepowers to achieve exceptional trip times. For example, with 1,200 hp effective, and linear speeds limited to 240 ft/min maximum, a hydraulic rig would complete a round trip from 16,000 ft in under three hours. This includes 20 minutes for changing slips, adjusting grips for the drill collar, and for bit changing. Operations could be speeded up with more elaborate equipment, but it is doubtful that this would be justified economically.

The driller needs more than one helper for all the detail jobs around the location, and two helpers are enough for all other crew duties if they are freed of the labor of round trips. Full value can therefor come from the automation of pipe-pulling and running only, keeping the rig simple enough to reach oilfield standards of reliability.

Keeping dirt out of hydraulic systems is said to be difficult, but field trials completed in the UK recently included repeated rig moves with a hydraulic transmission, and no difficulties whatever were encountered, although no special connections were used. An independent study by one USA oil company credited it with a potential 13% cost saving on a 10,000-ft hole in hardrock country, using standard subsurface rotary practice.

(*Continued on page 98*)

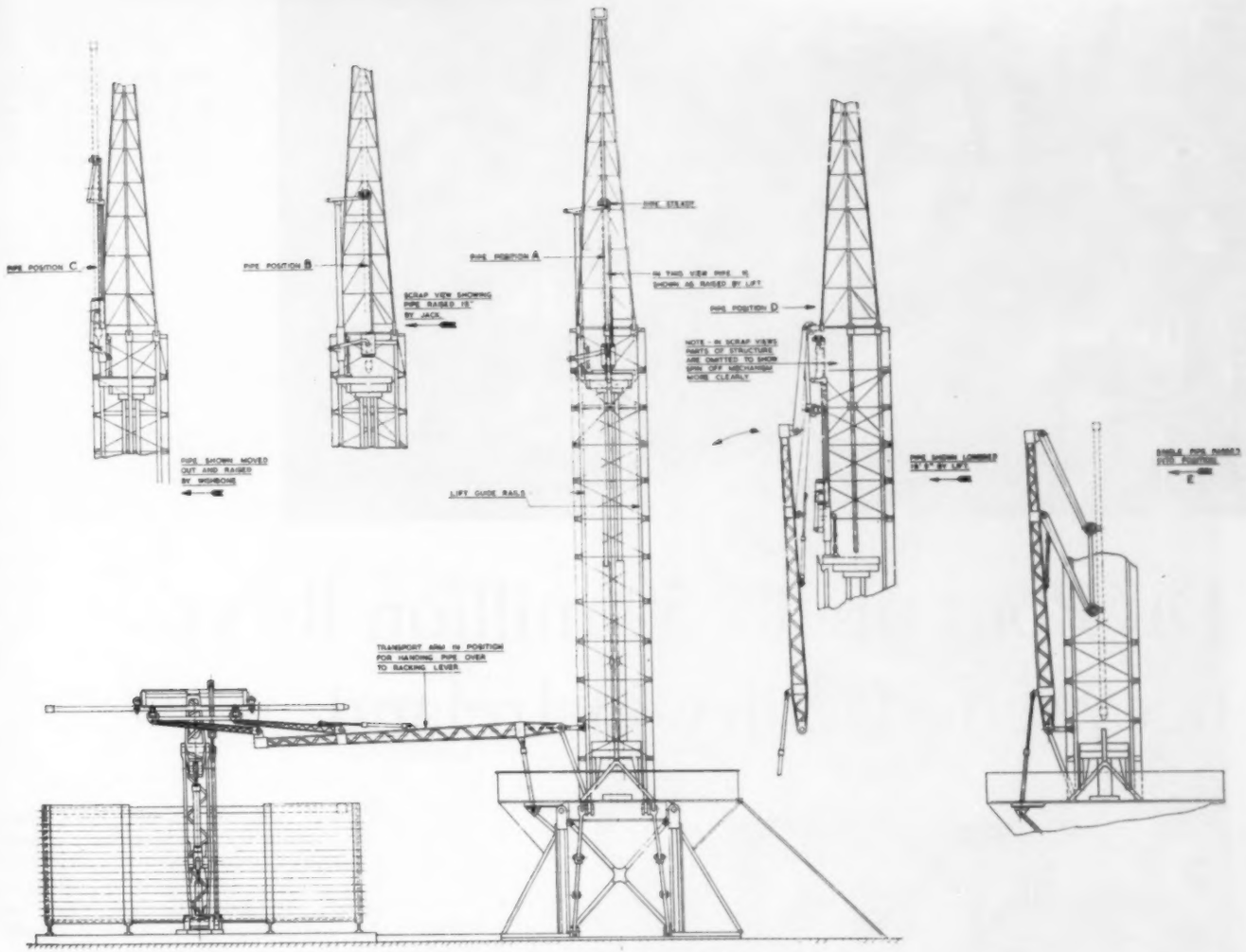

PIPE POSITION C
PIPE POSITION B
PIPE POSITION A
PIPE POSITION D
PIPE STEADY
IN THIS VIEW PIPE IS SHOWN AS RAISED BY LIFT
SCRAP VIEW SHOWING PIPE RAISED 15" BY JACK
NOTE - IN SCRAP VIEWS PARTS OF STRUCTURE ARE OMITTED TO SHOW SPIN OFF MECHANISM MORE CLEARLY
PIPE SHOWN MOVED OUT AND RAISED BY WISHBONE
LIFT GUIDE RAILS
TRANSPORT ARM IN POSITION FOR HANDING PIPE OVER TO RACKING LEVER

Fig. 2 General arrangement of new rig, showing various pipe positions during operation

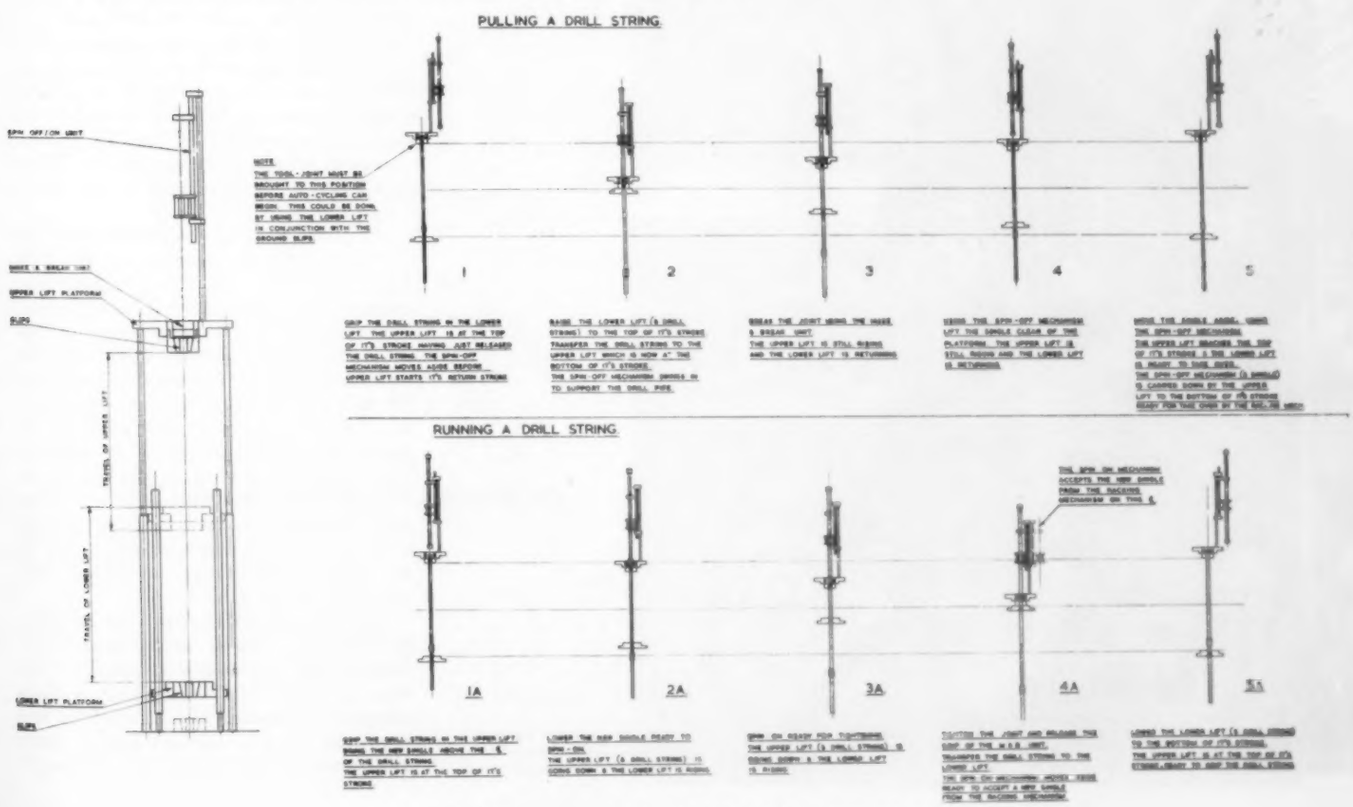
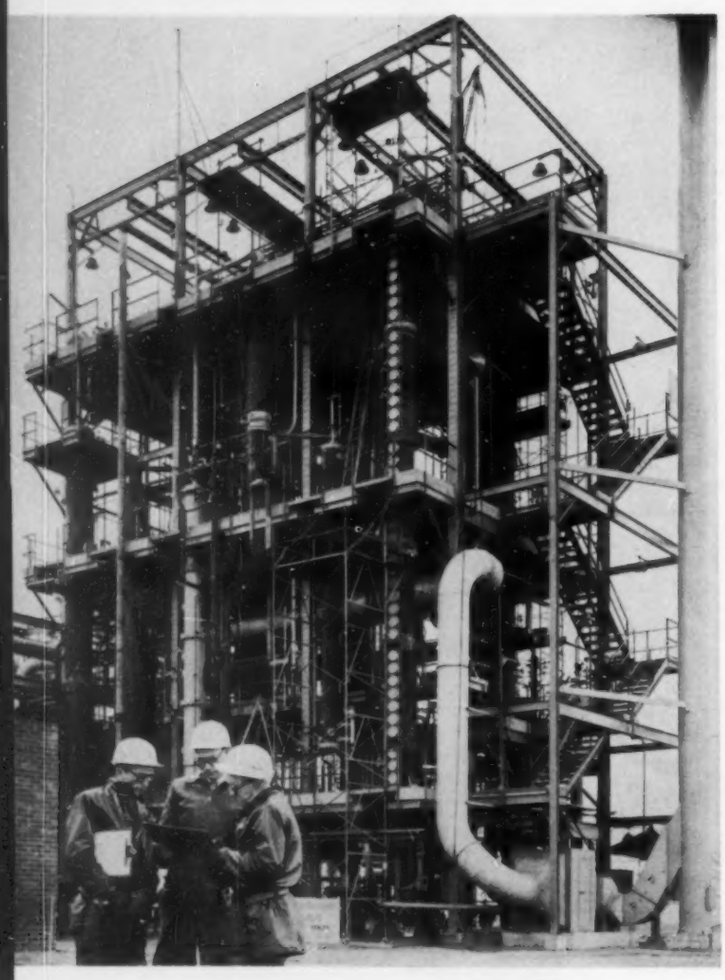


Fig. 3 Sequence of operations in pulling and running a string

Night view highlights a part of the complex Maydown Works of Du Pont (United Kingdom) Ltd. near Londonderry, Northern Ireland, for production of neoprene synthetic rubber

Du Pont opens 50 million lb/yr neoprene facility in Ireland



First step in making neoprene is this monovinylacetylene area at Du Pont's new Maydown plant

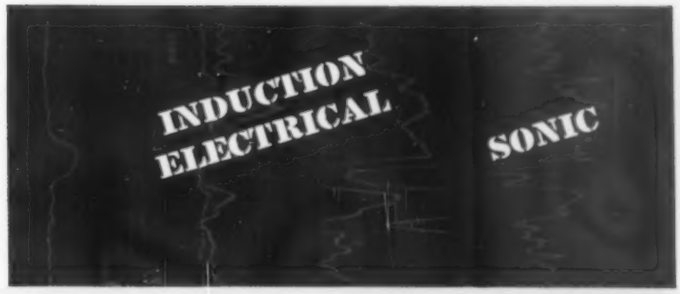
EUROPEAN DEMAND for neoprene is growing so rapidly that when du Pont (United Kingdom) Ltd. dedicated its new 50 million lb-yr neoprene synthetic rubber and latex plant at Maydown, Northern Ireland in July, it announced that plans were already under way for a 20% increase in capacity.

The new facility, on a 365-acre site close to Londonderry, is the first such plant outside the USA for the parent company, E. I. du Pont de Nemours & Co. of Wilmington, Del. It is expected to reach full productive capacity within the next few months. It was formally inaugurated by the Governor of Northern Ireland in the presence of Walter S. Carpenter, Jr., chairman of the parent firm.

Mr. Carpenter not only announced the plan for a capacity increase but also indicated that other du Pont products may eventually be manufactured at Maydown.

William H. McCoy, managing director of du Pont's UK subsidiary, said that of the 400 employed only 18 construction men and 35 operators had been brought over from the USA to help build and start up the plant—and several of the latter have already been replaced with UK personnel. The works general manager, John C. Weyrich, revealed that almost 95% of the construction materials and equipment used in the plant, totalling over £4 million, was purchased in the UK.

Neoprene is based primarily on acetylene and hydrogen chloride, rather than on petroleum. The acetylene is supplied by Carbide Industries Ltd. which built a plant alongside to produce calcium carbide and acetylene—the first calcium carbide plant in Northern Ireland and the first "tonnage"



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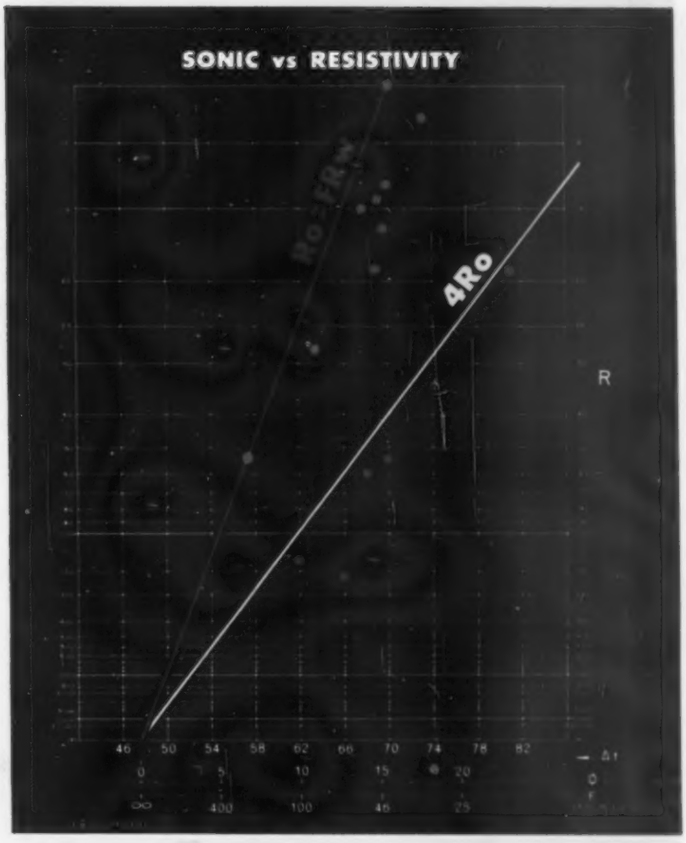

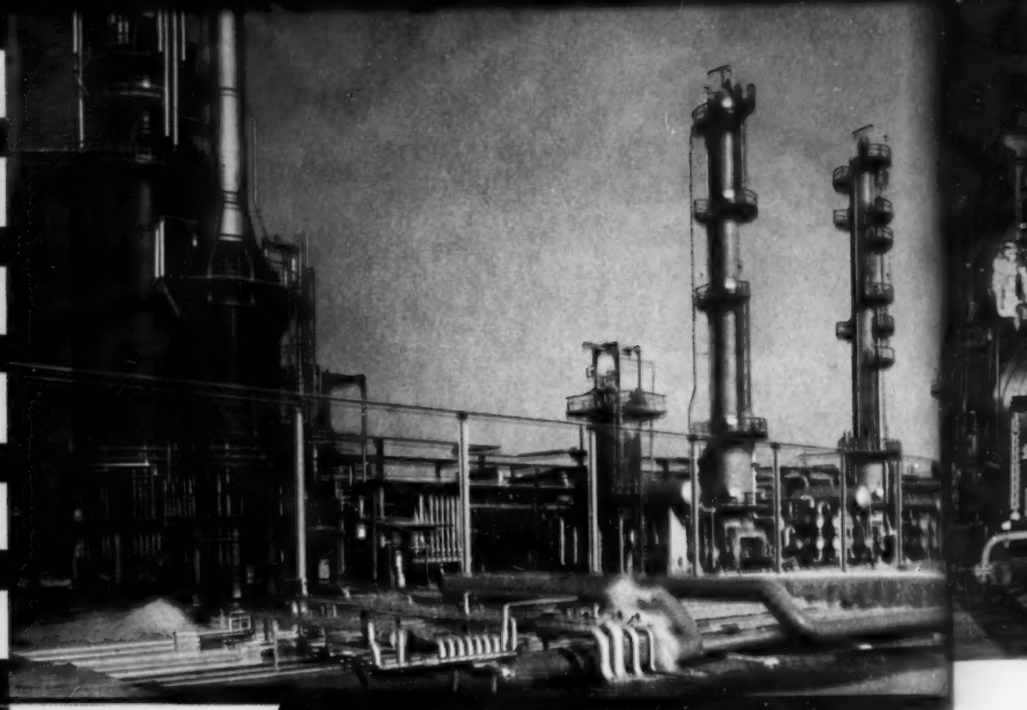

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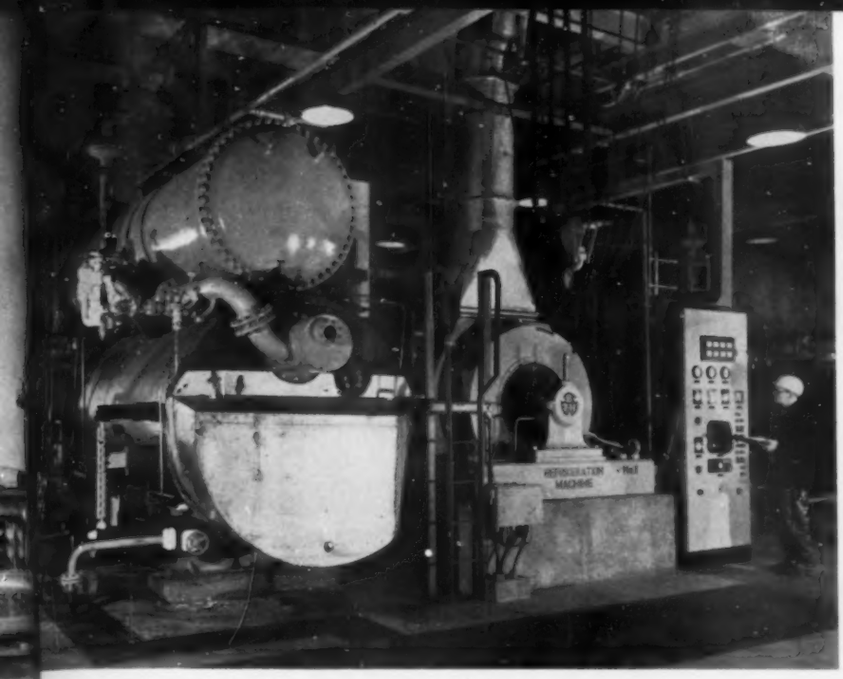
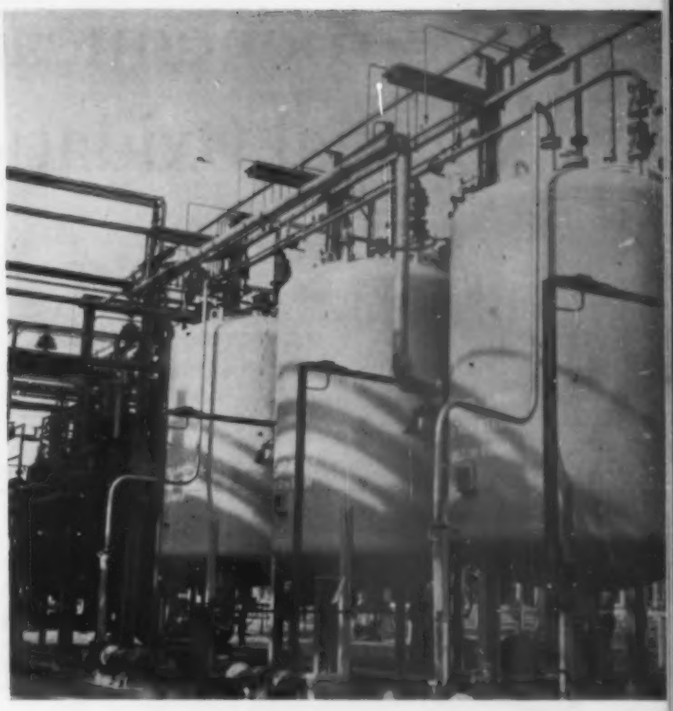


Refrigeration machines play an important role in the neoprene process at the Maydown Works



Right: Storage tanks for some of the raw materials used in neoprene manufacture at new Du Pont plant

acetylene plant project in the UK. Chlorine is purchased from Imperial Chemical Industries and brought in by a chartered, especially built boat in 200-ton cargoes from Runcorn.

The Maydown works was designed and engineered by the parent company's engineering department. The nitrogen plant was built to du Pont design by Air Products (Great Britain) Ltd.

The three major operating areas—MVA (monovinylacetylene), CD (chlorobutadiene), and polymerization—are serviced by separate nitrogen, hydrogen, and hydrogen chloride facilities.

Although the primary market for one third to one-half of the neoprene product will be the UK, a substantial amount will be exported to other Western European markets.

The new plant is part of the parent company's longterm program to invest some $40 to $50 million in Western European manufacture. Its foreign business in 1959 came to a total of $300 million, of which $115 million were sales of products made outside the USA.

There are now four subsidiaries in Western Europe apart from the UK: Du Pont de Nemours (Belgium) SA has been producing new types of paint at Malines since late 1959; Du Pont de Nemours (France) SA will produce herbicides in conjunction with another French company; Du Pont de Nemours International SA, in Switzerland, handles almost all the export sales of the parent in Europe and the exports of the other European subsidiaries; and Du Pont de Nemours (Nederland) NV is building an acrylic fiber plant near Dordrecht, to start operating in 1961; at 15 million lb/yr.

In addition, the company has entered into a joint venture agreement with "Sachtleben" fuer Bergbau und Chemische Industrie, a West German manufacturer of lithopone, to form a new company 26% owned by du Pont and 74% by "Sachtleben." The new company, Pigment-Chemie GmbH, will make titanium dioxide pigments at Homburg, starting late in 1961.

Du Pont (United Kingdom) will sell Maydown rubber directly to customers in the UK, but other European markets will be supplied by Du Pont International through distributors.

Completion of the new Northern Ireland plant is a valuable addition to the UK synthetic rubber potential. Stanley P. Chambers, chairman, Imperial Chemical Industries, has said:

"As a result of rising home production (57,000 tons last year), and of increased imports of synthetic rubber, the proportion of synthetic rubber to total new rubber being consumed in this country has gone up from 3.6% in 1954 to about 30.4% (i.e., 79,000 tons) in 1959. This proportion should continue to rise and it is quite likely that by 1970, synthetic rubber will have appropriated the major share of the total market, which is expected by then to be much expanded. It has been suggested that the United Kingdom will be producing something like 190,000 tons of synthetic rubber per annum in ten years' time; planned capacity so far announced exceed 150,000 tons."

This last figure was reached before the announcement of Esso Petroleum's major project.

A summary of the current known potential is as follows:

International Synthetic Rubber Co.—expanding its Hythe SBR plant, opened in 1958, from 70,000 to 90,000 ton/yr, and building a 2.5 million gal/yr plant for high solids latex.

Du Pont (United Kingdom) Ltd.—expanding its 50 million lb/yr neoprene plant at Maydown by 20%.

Shell Chemical Co.—building a plant with "substantial" capacity at Carrington, to make its new polydiene rubber.

Witco Chemical Co. Ltd.—building an 8 million lb/yr plant in the Midlands to produce synthetic rubber latices.

British Geon Ltd.—increasing its production of "Hycar" synthetic rubber; no capacity figures given.

Esso Petroleum Ltd.—planning a 30,000 ton/yr butyl rubber plant at Fawley.

Total UK imports of synthetic rubber of all types fell last year to 38,391 long tons, with a cif value of £8,973,266, from the 1958 total of 56,269 tons (£12,462,563), a drop which can be connected with the opening of International Synthetic Rubber's plant.

Such is the sign of highly increased demand, however, that imports in the first half of 1960, at 33,730 tons (£7,640,107), were very nearly equal to the whole of 1959.

Exports of synthetic rubber of UK production are combined with reclaimed rubber in the official statistics, and totals are as follows: 1958—9,209 tons (fob value of £852,329); 1959—17,378 tons (£2,217,-120); and January-June, 1960—14,665 tons for a value of £2,160,238. END

Petrochemical acrolein by the partial oxidation of propylene

by Peter W. Sherwood*

TWO DEVELOPMENTS of the last two years promise to make acrolein an important intermediate in the petrochemical industry. Foremost is the commercialization of Shell's new process for the synthesis of glycerine in which acrolein serves as key intermediate. Still in the research stage are two promising processes developed by Hoechst and Degussa for the manufacture of polyacrolein with molecular weights ranging from 50,000 to 300,000.

Because of acrolein's high reactivity and chemical simplicity, it has long been recognized that this chemical offers important potential as an intermediate. Actually, market growth had been held back by technical problems involved in handling the material as well as by insufficiently developed end uses.

Now, with acrolein joining the ranks of large-scale petrochemicals, a drop in price from the current 46¢/lb to less than 30¢/lb is anticipated.[30] Such a development will undoubtedly open new markets for this chemical. Among acrolein derivatives, other than glycerine and its intermediate, allyl alcohol, the following appear at present to be the most promising for early commercialization:

(1) High molecular weight polyacrolein, to be used in surface coatings.

(2) Glutaraldehyde, which shows promise in leather tanning and textile finishing.

(3) Acrolein dimer, a chemical intermediate for a line of polymers and plasticizers and for α-hydroxyadipaldehyde, a fabric shrink- and wrinkle-proofing agent.

These derivatives are closest to commercialization. In addition, acrolein constitutes the building block for a very large line of derivatives, for which considerable market development remains to be done.

Although acrolein has only now reached large-scale production, it has been available in commercial and semi-commercial quantities for some time. From 1946-1948, Shell operated a 20,000 lb/month plant for production of acrolein by the decomposition of diallyl ether. Commercial production of acrolein was started by Union Carbide in 1955. In this case, acrolein was produced by the condensation of formaldehyde with acetaldehyde.

Partial oxidation of propylene has provided the key to economic production of acrolein in a large-scale installation, and this approach is incorporated into Shell's new synthetic glycerine process which was taken on stream at Norco, La. in late 1959. This is today the largest acrolein plant, with an estimated capacity of 30 million lb/yr. It has furthermore been reported[30,31] that Union Carbide has shifted its production of acrolein from aldol condensation to the partial oxidation of propylene.

A number of other methods of acrolein synthesis have been investigated in the laboratory and pilot plant, including the dehydrogenation of allyl alcohol, the dehydration of glycerol, and the partial oxidation of propane. Some recent interest has been shown especially in the latter method[1] in which propane is air-oxidized over cuprous oxide catalyst on a carrier, in the presence of sulfur compounds which act as promoters in this particular action. Yield of acrolein is stated to be about 35% on propane reacted; however this is achieved at conversion of propane which is as low as 2.5-3% per pass.

Because of its importance and novelty as a commercial process, the present discussion will be confined to the synthesis of acrolein by the partial oxidation of propylene, in accordance with equation 1:

$$CH_2{=}CH\text{-}CH_3 + O_2 \longrightarrow CH_2{=}CH\text{-}\overset{O}{\overset{\|}{C}}H \quad \ldots\ldots (1)$$

Either air or purified oxygen may serve as oxidizing agent charged to the acrolein plant. Within the reactor, however, it is preferred to use dilute oxygen in order to reduce the risk of explosion. The diluent may be nitrogen, carbon dioxide, or steam.

For a once-through operation, use of air is more suitable—but if the unconverted olefin must be recycled, use of oxygen may be justified in terms of hydrocarbon savings.

The feed hydrocarbon must be essentially free of sulfur and isopropanol which act as catalyst poisons[1,12]. Also objectionable is the presence of isobutylene (and other higher olefins), which are converted to acrolein homologues at oxidation temperatures below those required for propylene itself. Presence of hydrocarbons other than olefins is reported[8] to be permissible because these materials are not attacked under reaction conditions.

Oxidation of propylene to acrolein competes principally with complete combustion of propylene to carbon dioxide and water which may take place directly or by the destructive oxidation of product acrolein:

$$CH_2{=}CH{-}CH_3 + O_2 \longrightarrow \begin{cases} CH_2{=}CH{-}CHO \\ CO_2 + H_2O \end{cases} \quad \ldots (2)$$

Of these two complete combustion routes, the direct formation of carbon dioxide is predominant. The destructive oxidation of product acrolein occurs most particularly in the presence of catalysts which have a high copper content[4].

In addition, the partial oxidation of propylene is accompanied by formation of formaldehyde and acetaldehyde in significant amounts, as well as by the production of carbon monoxide, organic acids, various carbonyl compounds and relatively small amounts of polymers which may show up as catalyst deposit (see later discussion).

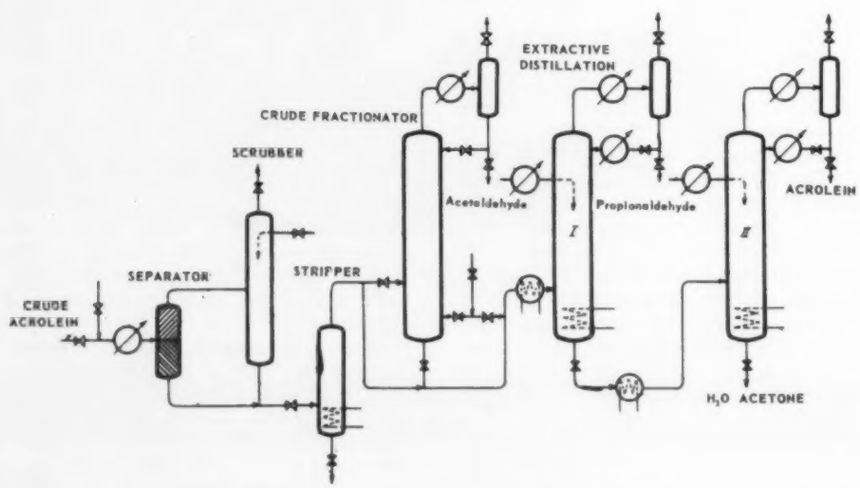
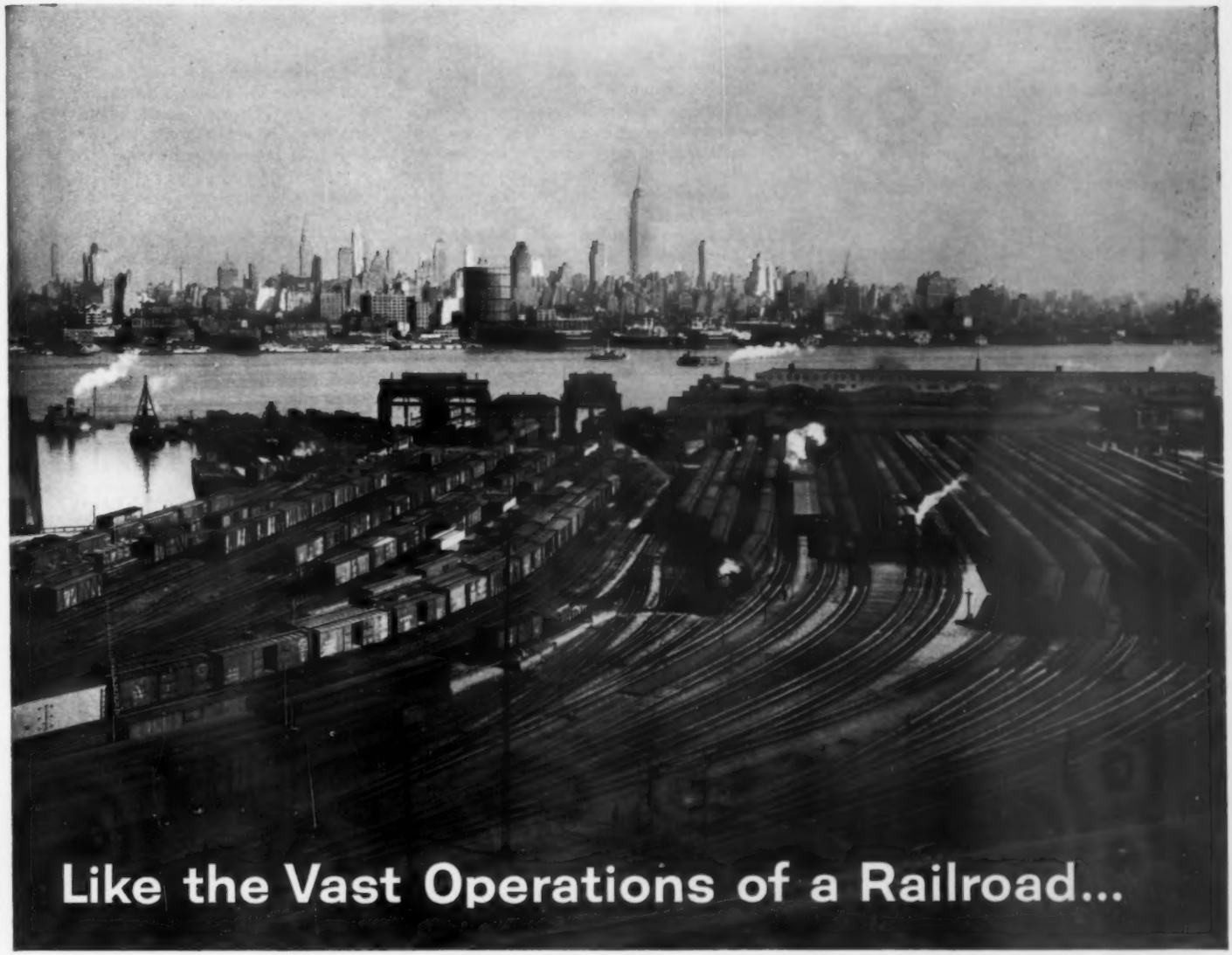


Fig. 1—Process for recovery and purification of crude acrolein

*Chemical Engineer, White Plains, N. Y.



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CITIES SERVICE

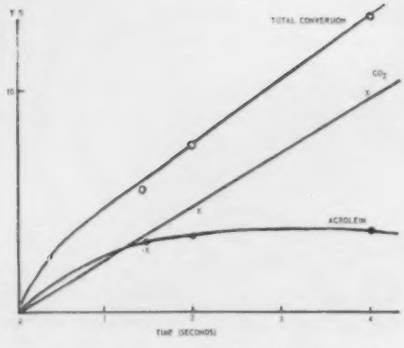


Fig. 2—Percent conversion of propylene as a function of contact time at 400 C (0.25% Cu on pumice). Reference 4.

Conversion of propylene to acrolein is accompanied by the evolution of 3800 Btu/lb (NTP). Even more exothermic (20,500 Btu/lb propylene) is the complete combustion reaction which takes place to a significant extent. In the case of fixed-bed reactors, it is therefore necessary to provide internal cooling, e.g. by the use of shell-and-tube converters. Use of fluidized-bed reactors has also been mentioned as a possibility[6].

Key to the successful partial oxidation of propylene to acrolein is the choice of a sufficiently selective catalyst. Numerous catalysts have been investigated for this reaction. Thus, Isayev[4] reports that oxidation of propylene over concentrated V_2O_5, M_0O_3, WO_3, and UO_3 leads almost exclusively to the formation of formaldehyde and acetaldehyde. When these catalysts were used in dilute form (on a pumice carrier), formation of acrolein in significant quantity was also observed. It is interesting that

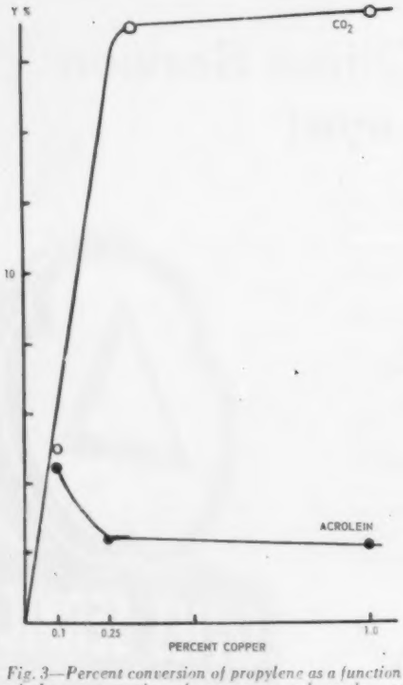


Fig. 3—Percent conversion of propylene as a function of the concentration of copper on carborundum at 400 C. Reference 4.

complete combustion over these catalysts plays only a minor role below 550C.

In the presence of metallic silver catalyst, oxidation of propylene at 200-400C resulted almost exclusively in complete combustion, with the formation of only minor quantities of saturated aldehydes. Mixtures of CuO + MoO_3 and CuO + V_2O_5 as well as $CuAl_2O_4$ catalyzed conversion of propylene to formaldehyde, acetaldehyde, some acrolein, and carbon dioxide.

Three types of catalyst have been given extensive coverage in the patent literature: supported cuprous oxide, copper oxide in the presence of selenium, and mixtures of various heavy metal oxides (notably copper oxide) with tellurium oxide. Use of these three catalysts for acrolein production will be considered in more detail in this discussion. Main emphasis will be placed on use of supported cuprous oxide which appears to be the only type of present commercial importance.

A. Supported Cuprous Oxide Catalyst

The selectivity of supported oxide catalyst is greatly influenced by the concentration and oxidation stage of copper. Isayev et al.[4] have shown that acrolein yield rises—and carbon dioxide formation decreases—as the catalyst's copper content is decreased. This effect becomes more pronounced with increasing reaction temperature. Maximum acrolein yield was observed with 0.25% copper on pumice and 0.1% copper on carborundum.

Similarly, Belyaev et al[20] show that high copper content is objectionable. Their best performance was obtained with silicon carbide containing 1—1.5% copper oxide. At significantly higher concentrations, copper occurred on the catalyst as metallic copper which favors CO_2 formation. Good acrolein yield requires that all copper be present in the form of its oxide.

It should be noted in this connection that Connolly[8] calls for a minimum concentration of 2% copper oxide on silica gel while Cheney[5] prefers copper concentration between 5 and 15% on aluminum oxide carriers such as Aloxite.

On dilute catalysts, copper is present predominantly as a mixture of cuprous and cupric oxide. Popov and Vermel[12] have shown that, regardless of the form in which copper is initially deposited, it will be transformed to essentially an equilibrium mixture, whose composition is determined by the ratio of propylene to oxygen passed over it. In the case of 1.5% copper oxide on silicon carbide, exposed to a mixture of propylene and oxygen in 7.5:1 molar ratio, the catalyst reached a final composition of 70% cuprous oxide and 30% cupric oxide. This operating range is typical of optimum experience (normally recommended reactants' ratio is 9:1).

If substantially higher hydrocarbon: oxygen ratio is employed (e.g. 30:1,), a significant portion of the catalyst is reduced to metallic copper. The result is a sharp drop in acrolein yield.

These findings are consistent with the observation that the activity of ageing catalyst can be restored by changing the composition of the process stream. This aspect will be considered below in our discussion of catalyst regeneration.

Within the major category of supported copper oxide catalysts, a number of specific catalysts are claimed to be particularly effective. Thus, Baldwin[9] calls for deposition on the carrier, and subsequent decomposition, of copper salts of large molecular size, such as copper phthalocyanine.

Voge and Atkins[7] report that dilute copper catalysts prepared by impregnation of the carrier with a copper salt solution, followed by decomposition, lack in uniformity and durability. As a result, operating difficulties and catalyst deterioration are observed. Production of more rugged catalysts is claimed when copper salts in alkaline solution are reduced in the presence of the catalyst carrier.

Numerous catalyst carriers have been proposed. According to Voge[7], the preferred carrier has relatively non-porous surface (e.g. silicon carbide, or ceramically bonded alumina and silica composites such as Alundum). Isayev[4], however, reports that no real difference was observed in the yields obtained over pumice and over low-porosity carborundum. Although aluminum oxides are reported in the patent literature, work by Popov indicates that presence of these materials has a clearly deleterious effect on acrolein yield.

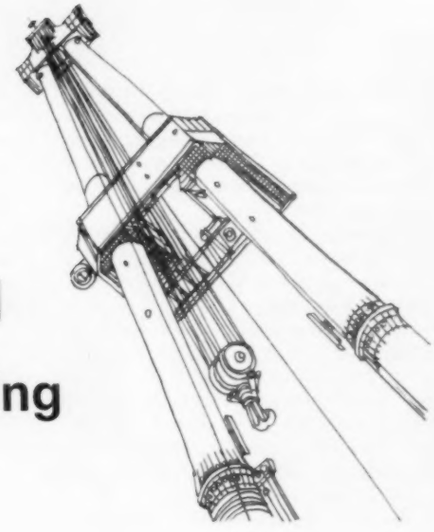
Significant improvement in acrolein yield has been claimed for the use of chlorine[14] or iodine[5] as promoters, which are introduced as such or in the form of organic halides. Addition of iodine is claimed to prolong catalyst life substantially and to permit conversion per pass of about 80% to form acrolein in 75% yield. In the absence of iodine and at otherwise comparable operating conditions, high acrolein yield could be obtained only by limiting per-pass conversion of propylene to 25%.

Dilute catalysts exhibit greater stability than is observed with higher copper concentrations. For any given catalyst, active life depends on operating conditions, above all on reactants' ratio (as discussed above) and on temperature; useful onstream life of catalyst has been reported as high as 2000 hours—probably not the limiting value.

Deterioration of catalyst takes two directions: qualitative—i.e. the selectivity of the catalyst is reduced; and quantitative—i.e. total rate of oxidative conversion declines, with or without change in selectivity. Available evidence suggests that loss in selectivity is due chiefly to changes in the state of oxidation of the copper component while decline in overall activity may be traced to loss of active centers on the catalyst surface, e.g. due to catalyst poisons or due to the deposition of polymeric carbonaceous materials.

Accordingly, regeneration of the oxidation catalyst may also take two fundamentally different courses: (1) change in operating conditions (reactants' ratio, temperature) to alter the chemical character of the cop-

Engines designed for oil drilling



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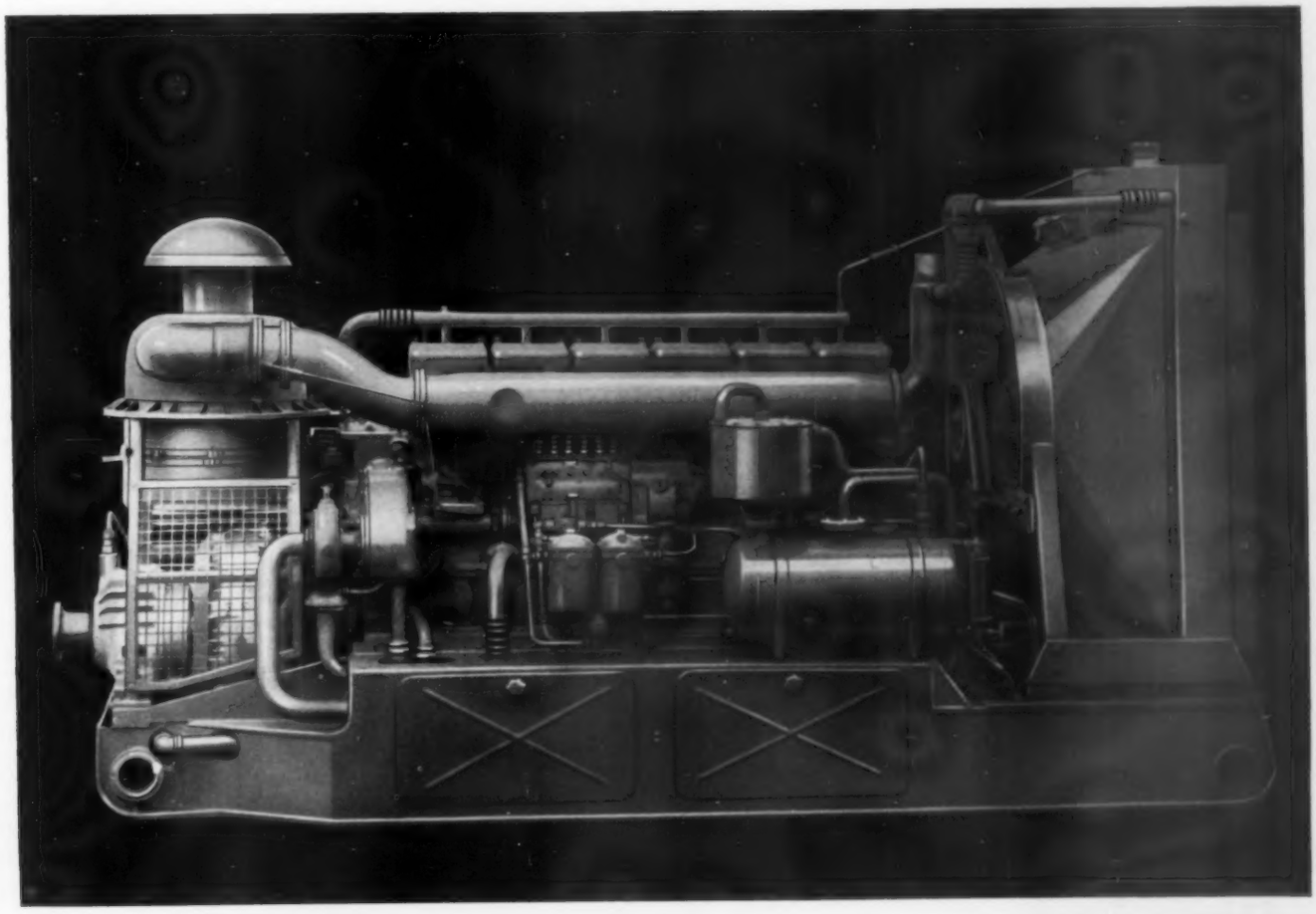

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per oxides, and (2) burn off carbonaceous deposits by passing nitrogen- or steam-diluted oxygen over the catalyst at higher temperature (400-500C). Specific details for effecting regeneration by these methods are reported by Detling[6,15] and by Connolly[8].

Effect of Operating Conditions

The effect of *pressure* on conversion to acrolein is not very pronounced in the range from atmospheric pressure to 250 psig. Accordingly, the reaction is normally carried out at approximately atmospheric pressure[5] in order to avoid the occurrence of conditions which might lead to explosion or autoignition of the reaction mixture.

Propylene:oxygen ratios ranging from 2:1 to 30:1 have been reported as being useful. Almost universally, however, the favored propylene:oxygen ratio is near the lower end of this scale; i.e. a moderate excess of hydrocarbon. The effect of higher ratio on catalyst chemistry and with it on selectivity has been discussed above. It is interesting to note that an excess of oxygen is preferred for propylene oxidation in the presence of selenium which will be considered below.

Reaction temperature should be between 200 and 450C. At higher temperatures, complete combustion is excessive and the catalyst becomes damaged while, at lower levels, reaction rate is insufficient. Connolly[8] states that the preferred operating range is between 250 and 320C. However, the bulk of work with dilute copper catalysts has been carried out at 350-400C.

As pointed out above, it has been proposed[6] that catalyst be regenerated in the presence of the normal process stream by changing the operating temperature. If the pressure during regeneration is the same as during the on-stream period, the temperature increase should be between 10 and 55% on the centrigrade scale. For example, if operation is normally carried out at 350C, the temperature of the catalyst during reactivation will be between 400 and 500C. This large increase in temperature is only intermittent.

Selectivity of acrolein formation drops rapidly with increasing contact time, evidently because product acrolein is subjected to complete combustion unless it is promptly removed from the reaction zone. Work by Isayev[4], using 0.25% copper on pumice at 400C, indicates that maximum selectivity is maintained up to about 0.3 seconds contact time. At a contact time of one second, propylene is converted to acrolein and to CO_2 in approximately equal amounts. Almost no increase in net acrolein formation is shown at contact times exceeding 1.5-2 seconds while carbon dioxide formation continues to rise sharply.

B. Catalysis in the Presence of Selenium and Tellurium

The addition of selenium and tellurium to copper catalysts causes significant improvement in selectivity. Isayev[4] finds that CuSe, CuTe and Cu_3As cause only slight carbon dioxide formation during the oxidation of propylene. However, these catalysts are also relatively inert, permitting only small conversion to acrolein. At reaction conditions, copper selenide is also reported to be rapidly deteriorated.

Use of selenium and tellurium raises a problem of health hazard and of recovering these materials (especially more volatile selenium) from the reactor exit stream. However, sufficient work has been done with promoters of this type of copper-based catalysts to warrant consideration in this place. Use of selenium in this conjunction has been investigated particularly at Distillers Co., Ltd. while copper-tellurium catalyst compositions have been patented by Socony-Vacuum.

In the work of Distillers Co. the catalyst is copper oxide deposited on silica gel or activated alumina. Selenium is introduced in vapor form with the propylene-air mixture subjected to oxidation. Recommended concentration of this promoter is 0.008 to 0.12 mg selenium per liter gaseous mixture[2]. Good catalyst activity and efficiency has been reported to continue beyond an on-stream life of 2000 hours.

Operating temperature is 250-350C. Data due to Hadley[2] show that, within this range, selectivity remains fairly constant at about 70%, but that per-pass conversion to acrolein increases by 230% as the temperature is raised from 280 to 340C.

Preferred propylene concentration in the feed stream is about 2% while oxygen content should be not less than 10%. Gas mixtures in this range are outside the explosive limit. The high oxygen:propylene ratio is claimed to result in high conversion rate of the olefin and to permit economic operation without propylene recycle.

In a typical run[16], a catalyst was employed which contained one mole copper (in the form of copper oxide) per nine moles silica. 25 liter/hr of 2% propylene in air, containing 0.025 grams/hr selenium, was passed over 16 grams of this catalyst at 320C; 70% of the propylene feed was converted to acrolein and 17% to CO_2.

Because of its toxic nature, selenium must be removed almost completely from the reactor gas. Such quantitative removal can be achieved by passing the gases through activated charcoal[17] which will adsorb as much as several percent of its own weight selenium. Gas so treated is reported to contain less than one-millionth gram selenium per liter. Because of its relatively low volatility a portion of the selenium passed through the reactor is condensed in the cooler parts of the reaction system. Some of this selenium is present in the form of its oxide, which can be reconverted to elemental selenium by heating to 240-400C[3].

Tellurium oxide on alumina catalyzes the partial oxidation of propylene to acrolein. Available data indicate very low conversion per pass which can be boosted somewhat by introducing small concentrations of chlorine or bromine with the feed gas[20]. Higher conversion rates are reported for catalysts containing mixed uranium and tellurium oxides on a support. Over such a catalyst, Middleton[19] reports a 25% total conversion of propylene per pass, with an acrolein efficiency of 80%.

C. Product Recovery

Oxidation of propylene-containing hydrocarbons results in the formation of a complex mixture consisting not only of acrolein but also other reaction products such as acetone, acetaldehyde, propionaldehyde, etc. Also present are permanent gases, notably carbon monoxide, carbon dioxide and nitrogen. Finally, separation must be effected from unconverted hydrocarbons and some water.

As first step in product purification, the reaction gases are quenched by contact with water or with liquid propylene (in the latter case, the primary recovery system must be operated at about 250 psig.)

Fig. 1 illustrates a process in which water scrubbing is employed. The product of oxidation is water-quenched and enters a phase separator. Here, a liquid layer containing crude acrolein, close-boiling carbonylic impurities, formaldehyde, water, and high-boiling organic materials is separated from a gaseous fraction containing the normally gaseous materials as well as substantial amounts of acrolein and other close-boiling carbonyl compounds.

The gaseous phase is water-scrubbed for recovery of its acrolein content together with other, water-soluble compounds. This absorption column is operated at 150-250 psi and 10-30C. The rich liquor leaving the scrubbing column is taken to a stripper in which acrolein, together with associated carbonylic impurities and some water is taken off overhead.

Composition of the vapor stream leaving the stripper depends on conditions employed in the oxidation stage. In general, carbonylic impurities will not exceed 10 wt-% of the total organic content of this stream. Water content will be at least equal to the composition of the acrolein-water azeotrope (2.7 wt-% water at amospheric pressure.) The following composition is reported[23] to be typical of the vapor leaving the top of the stripper:

Component	wt-%
Acrolein	80 to 90
Acetaldehyde	3 to 10
Propionaldehyde	0.5 to 3
Acetone	1.0 to 5
High-boiling organic material	1.0 to 2.0
Water	2.4 to 6.0

This stream is first of all subjected to fractionation for the overhead removal of acetaldehyde. This component has a normal boiling point of 21C vs. 52.5C for acrolein and the relative volatility of the two compounds, in the absence of a solvent, is about 3.5. Accordingly, distillative removal of most of the acetaldehyde present in crude acrolein does not constitute a difficult operation.

Essentially all the product acrolein leaves the acetaldehyde via the bottoms, in which

(*Continued on page* 121)

...his bridge to a new world

The river bank once marked the boundary of this boy's life. But soon this bridge will open a new world to him. He'll meet new people, new ideas—and new opportunities.

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Unloading barges at the staging area on the Mackenzie River. Tractors work in tandem due to muddy condition, as did the fork lift trucks which proved very useful. In foreground, part of production casing.

One of crew members working in sub-zero temperature. Note frozen nose.

Moving a rig to an Arctic well

Above: Peter Bawden Drilling Ltd.'s DC-3 airfreighter loading portable bunkhouse for trip to rig location 45 miles north of Arctic Circle.

Left: Frozen lines often had to be thawed with a blow torch.

Below: Cold weather is their specialty. Six of the Eskimos in the drilling crew.

THE MOST NORTHERLY WELL ever to be drilled in Canada—45 miles north of the Arctic Circle and 175 airline miles from the Arctic Ocean at Mackenzie Bay—was spudded in December 26, 1959. The well, Richfield et al. Grandview Hills No. 1, is now being drilled by Peter Bawden Drilling Ltd. Rig No. 16, and the photos on these pages illustrate the project last summer of moving the rig from Edmonton to the site.

A total of 1,700 tons of rig and supplies were trucked 550 miles by road to Hay River on the south shore of Great Slave Lake and then up the Mackenzie River by barge to a landing point 85 miles northwest of Fort Good Hope. Final leg of the move was in late November when subzero weather enabled tractors to move the rig 22 miles west of the river landing to the well site. Men and supplies were moved also by Bawden's airplane, a DC-3, to a landing strip on a frozen lake near the well.

Richfield Oil Corp. is operator for a five-company group drilling the well, including French Petroleum Co. of Canada Ltd., Clark Oil & Refining Corp., and Hudson's Bay Oil & Gas Co. Ltd. The group participated equally in acquisition of an 85% working interest in approximately 3.5 million acres in the Lower Mackenzie Basin

Above: Drawworks being placed on rig floor. There is no sun from early December until late in January.

Top right: Top section of derrick on trailer, being pulled by Caterpillar tractor on 22 mile trip from river to well site.

Right: Almost ready for final erection. Derrick is completely assembled and rigging up of balance of rig continues, prior to actual mast raising.

Right: Mast being raised, December 17, 1959.

Below: Rig up, ready to spud in, December 26, 1959. Large lake seen in background provided landing strip for aircraft which serviced the location.

area of the Northwest Territories from a group headed by Scurry-Rainbow Oil Ltd. The remaining 15% working interest is held by Canadian Devonian Petroleums Ltd., one of the original participants in the group that filed applications in 1957 and 1958 for the large block with the Dept. of Northern Affairs.

The program marks the first participation in Canadian exploration by Clark and is the first drilling venture in the Northwest Territories by French Petroleum, Canadian Devonian and Richfield.

The total load—rig itself (127 ft in height), enough drillpipe to reach 8,000 ft, production casing, bunkhouses, sleighs, motors, 100,000 gallons of fuel oil, diesel oil, and aviation gas—traveled 1,800 miles.

Drilling crew under Bawden's toolpusher Doug Parker number 25; including three shift crews of five men each, a geologist, cook, mechanic, and camp attendant. Six members of the crew are Eskimos, the first Eskimo roughnecks in Canada. Bawden says they learn fast; they've worked on a rig in Swan Hills, Alta.

Low temperatures make the work rugged —Fort Good Hope recorded a low of —73 F last winter—but aren't regarded as great a problem as an Arctic fall. END

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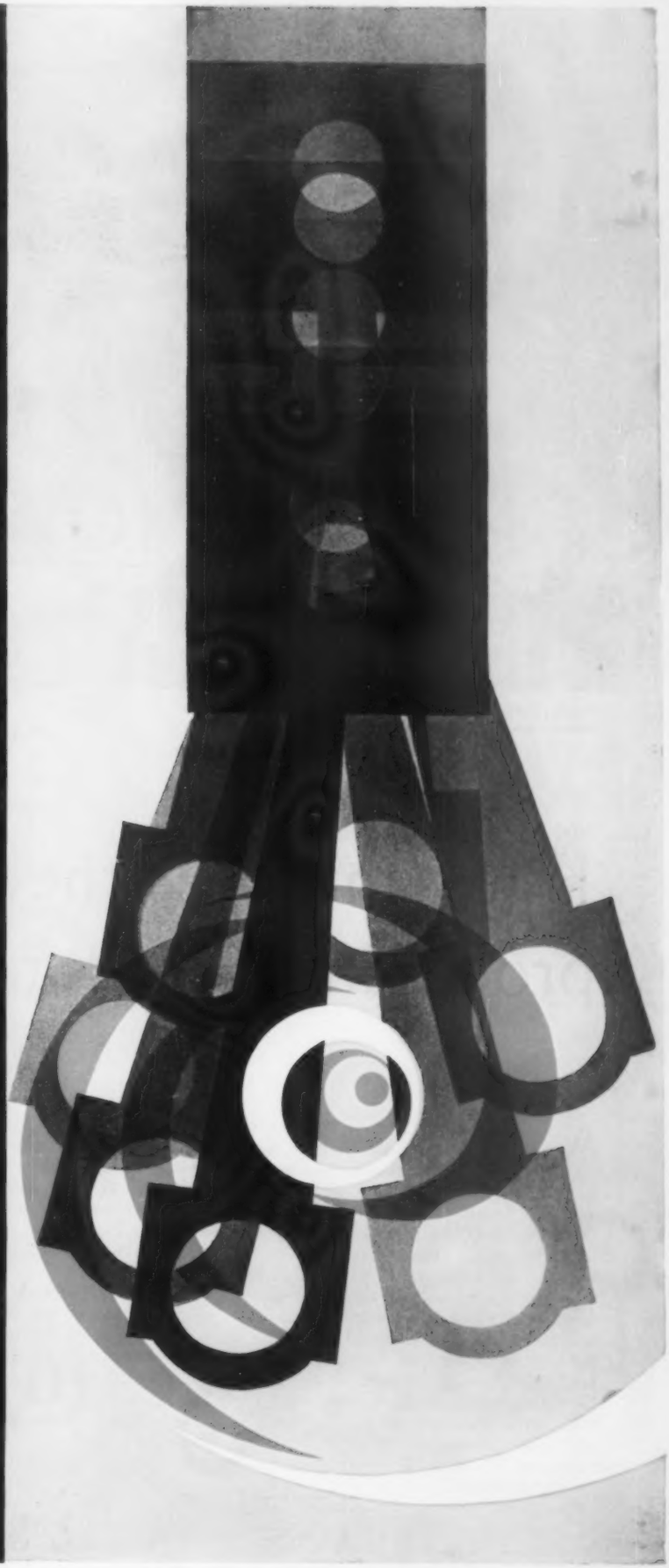
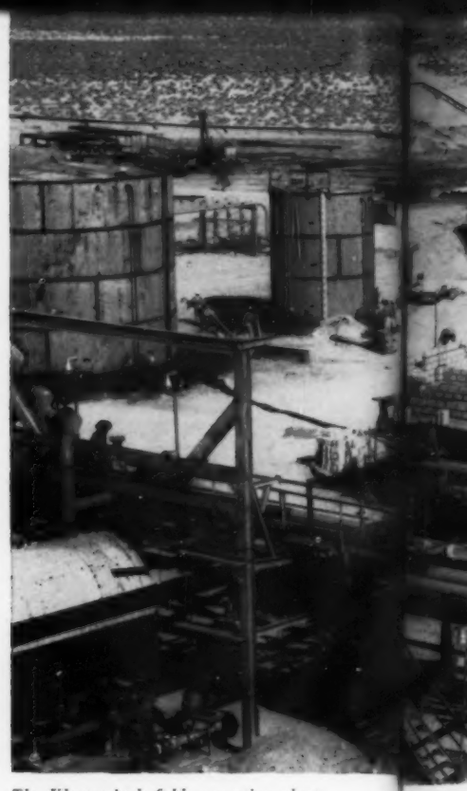


Pipeline between field plant and pumping station on the Safaniya-Ras Tanura line being tarred and wrapped.



The Khursaniyah field separation plant during construction late in 1959.

Khursaniyah is the sixth producing field for Aramco

WHEN ARABIAN AMERICAN OIL CO.'s new $2,790,000 gas oil separation facilities in the Khursaniyah field went into operation last summer, Aramco had opened its sixth producing field in Saudi Arabia. Those now in production are Damman, Abqaiq, Qatif, Ghawar, and Safaniya.

The new plant, with an average production of 45,000 b/d, is one mile north of the midpoint of the Safaniya-Ras Tanura pipeline, in the middle of the Khursaniyah field, approximately 105 miles northwest of Dhahran and 60 miles southeast of Safaniya. It has been under construction since August, 1959, and will be connected to the five producing wells in the Khursaniyah field as the first increment.

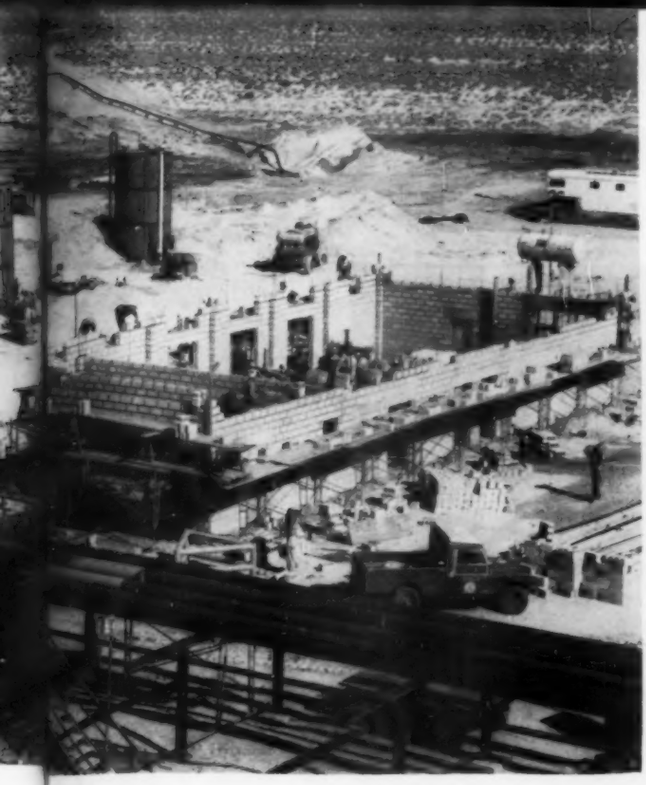
Flow lines 8 inches in diameter, the longest one about 16,000 ft, will bring crude into the plant. Separated oil will enter the Safaniya-Ras Tanura pipeline for delivery to Ras Tanura for stabilization and offshore shipment or for processing in the refinery.

The Khursaniyah crude, sour and of 32° API gravity, will be batch-flowed in the line with the Safaniya crude, which is sweet and of 27° API gravity. The two crudes will be segregated on arrival at Ras Tanura. A 4-km, 24-in tieline connects the plant with the 22-in Safaniya-Ras Tanura line.

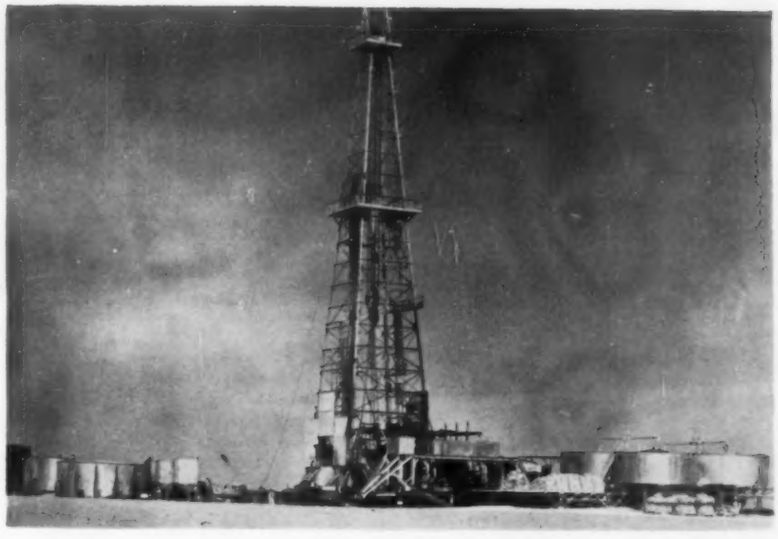
Facilities at Khursaniyah include the plant itself, generating facilities, living quarters, a road between the plant and the S-RT line pumping station, and other necessary auxiliaries. One difficult problem encountered in the development of the Khursaniyah site was the lack of potable drinking water. Initially, all drinking water will be hauled to the site. The non-potable water from a well drilled at the site will provide water for sanitation and fire protection purposes.

Oil was discovered at Khursaniyah in 1956, with Well No. 1 being completed Nov. 27 after reaching a total depth of 7,612 ft as an Arab D member producer. The well also encountered oil in commercial quantities in the Arab A, B, and C members. Delineation and development drilling was continued after the completion of No. 1, with a total of five being completed as producers in the field.

The presently proved area of the Khursaniyah field is about 11 km long and 7 km wide. Acreage of the field is 12,800. Minimum depth to top pay is 5,950 ft, and API gravity is 31-32. Altogether, as of the end of 1959, eight wells had been drilled, the five producers, two observation wells and one abandoned well. END

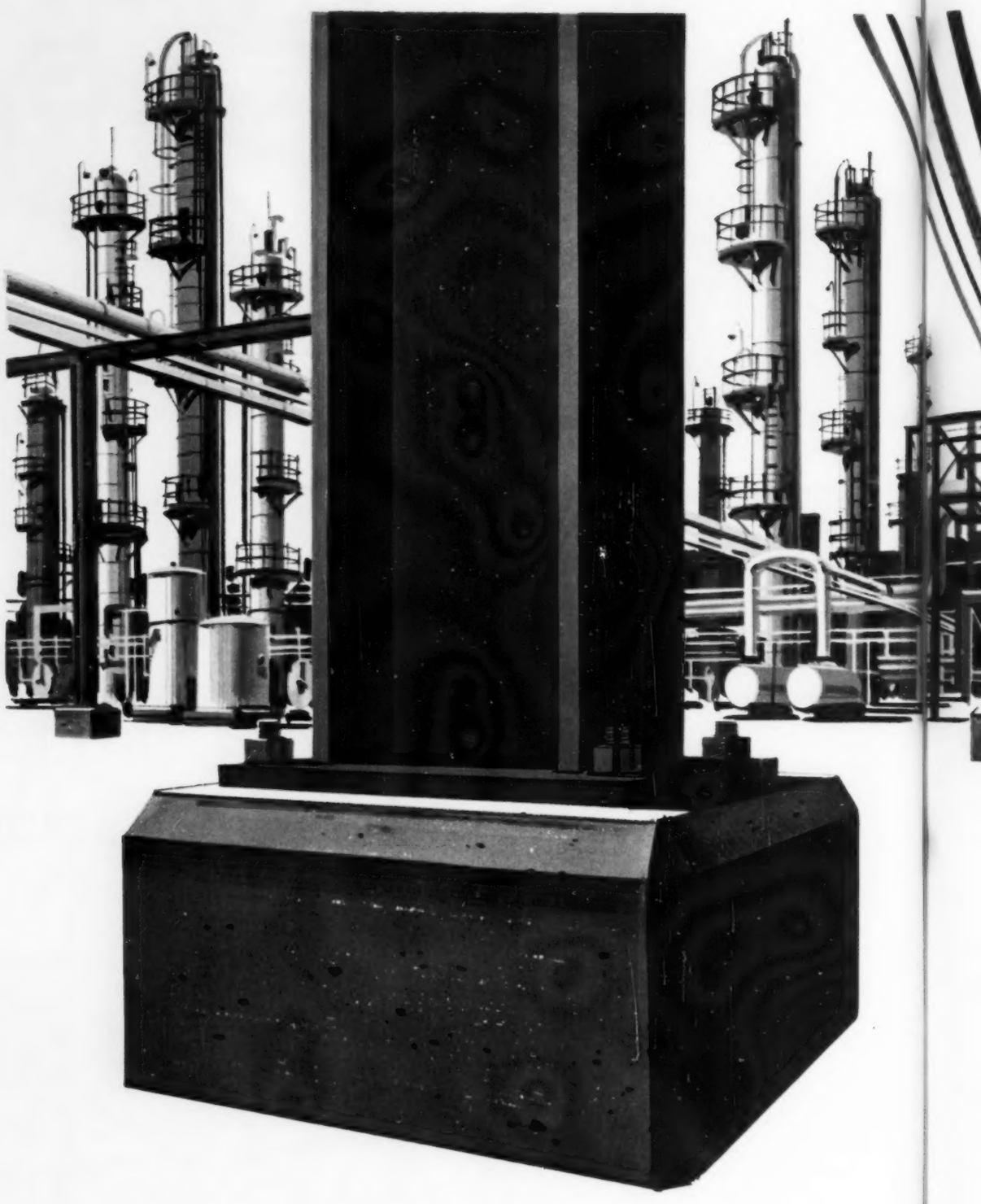


Above: Aramco mason sets block into place during erection of Khursaniyah plant control house.



Left: Khursaniyah No. 1, Aramco's discovery well in the field.

Below: Valve installation at entry of field flow lines to Khursaniyah plant.



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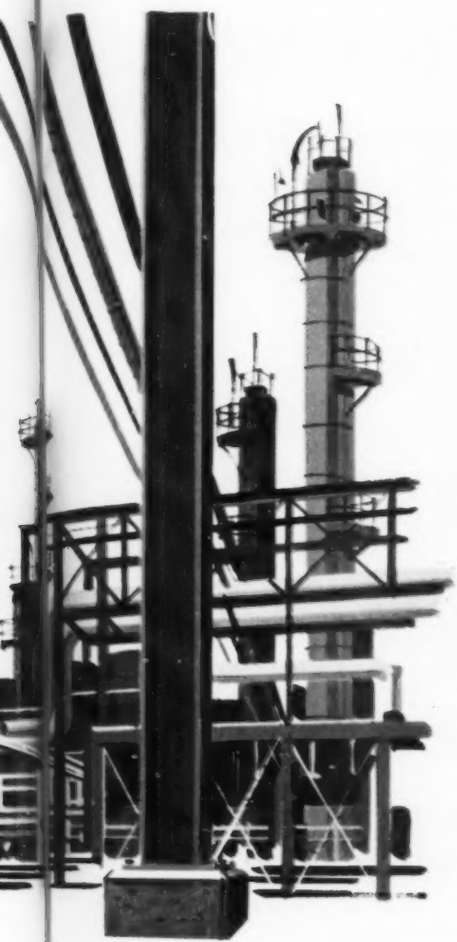

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Italian developments in petrochemical acetylene

LEADING ITALY'S booming petrochemical activity is increasing production of such materials as olefins and olefin polymers, synthetic rubber, nitrogenous fertilizers, oxygenated compounds, solvents, and plasticizers, many of them frequently from original processes developed by Italian scientists.

Few processes have progressed as rapidly during recent years as the synthesis of acetylene from petroleum and natural gas. Conventionally, acetylene has been manufactured only from calcium carbide in electric furnaces, with a consumption of 11 KWH per cubic meter of acetylene, plus 2.6 kg coke and 3.5 kg calcium carbonate.

Lately, the yields from this operation have been improved, and the electric power consumption has been reduced to 9 KWH per cubic meter C_2H_2. Progress in calcium carbide technology, however, could not overcome the intrinsic shortcomings of the process.

Acetylene has been prepared in the laboratory by Berthelot, the French chemist, back in 1860, by partial oxidation of methane. According the equation, $2CH_4 \rightarrow C_2H_2 + 3H_2 - 95.5$ kcal, one cubic meter C_2H_2 plus three cubic meters H_2 can be produced from two cubic meters CH_4, with a thermal requirement of 4,000 kcal (equivalent to 4.7 KWH).

To obtain high yields of acetylene from methane, temperatures in excess of 1400 C must be reached. At this temperature—unfortunately—acteylene is quickly decomposed to carbon and hydrogen. Very efficient quenching is therefore necessary to avoid decomposition and keep yields at commercially interesting levels.

Experiments on the practical realization of the above reaction have been carried out by F. Fischer (1930) and later by Sachse and Bartholomé (1946) in Germany. The latter succeeded in the erection of the first commercial plant for acteylene production by partial oxidation of methane, at the Ludwigshaven works of BASF.

In this process, oxygen and methane, separately preheated at 500 C, are intimately mixed and admitted to the reactor through a perforated plate of accurate design. Combustion temperature reaches 1500 C, and the flame is quenched by water sprays after 3 milliseconds. Gas is washed and filtered.

From one volume CH_4 and 0.6 volume O_2, about 1.8 volume of a mixture of the following composition is obtained: C_2H_2 8.5%; CO_2 3.8%; CH_4 6.5%; H_2 54.3%; CO 25.2%; C_2H_4 0.8%; $N_2 + C_nH_m$ 0.9%. Practically, only 24% of converted methane goes to acetylene; the remainder is transformed to carbon monoxide and hydrogen. This favors the operation of integrated petrochemical complexes where acetylene is manufactured via the partial oxidation route to utilize the large quantities of by-products hydrogen and carbon monoxide.

The problem of a more economical production of petrochemical acetylene (easier separation of product stream components, better heat recovery, combined production of acetylene and ethylene) has been thoroughly investigated by researchers with Montecatini, and discussed by Dr. Giacomo Fauser in a lecture in Milan before the Italian Society of Chemical Engineers (AIDIC)*. A resume of his lecture is given here.

Acetylene Recovery

For an economically sound acetylene production from methane, byproduct gases must be conveniently utilized. Owing to the high dilution of acetylene in the reaction products, its separation at the desired purity grade requires a substantial amount of energy for compression. If, however, the mixture obtained is fed directly to ammonia or methanol syntheses, the costs for compression could be distributed among more products.

Due to its peculiar properties, acetylene must be separated from the accompanying gases by absorption in a solvent, followed by solvent regeneration. This choice of the solvent is one of the critical problems.

Many solvents have been investigated for acetylene absorption, and several patents have been granted. Montecatini has adopted methanol for its low cost, good stability, and selectivity. The solubility of acetylene in

*The lecture was published in the Italian journal, La Chimica e L'Industria, February, 1960.

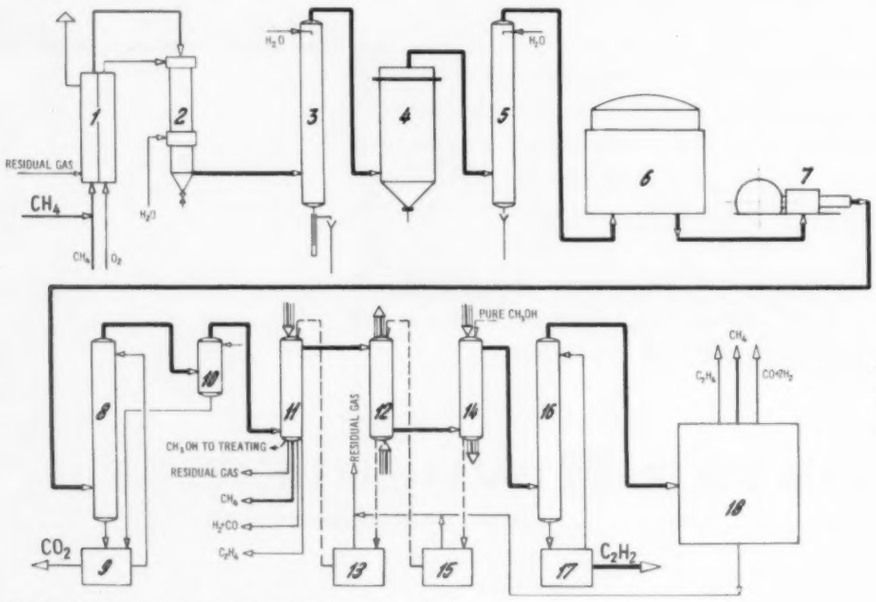


Fig. 1—Flow scheme of acetylene production from methane.

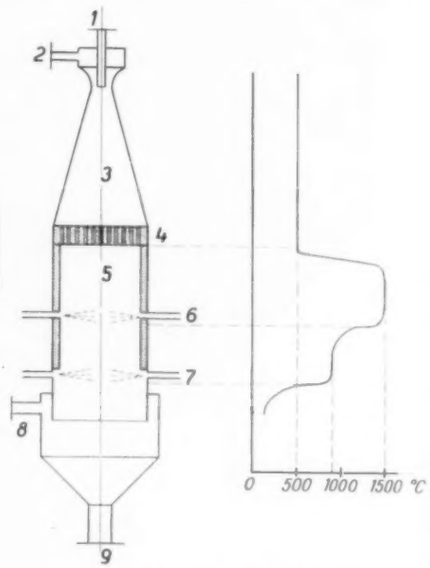
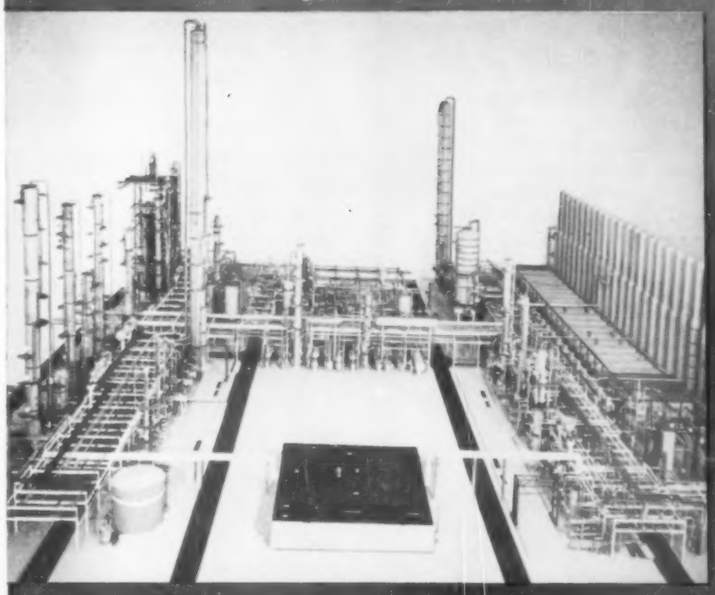


Fig. 2—Reactor for acetylene synthesis from methane and naphtha pyrolysis. Curve at right is reactor temperature profile.

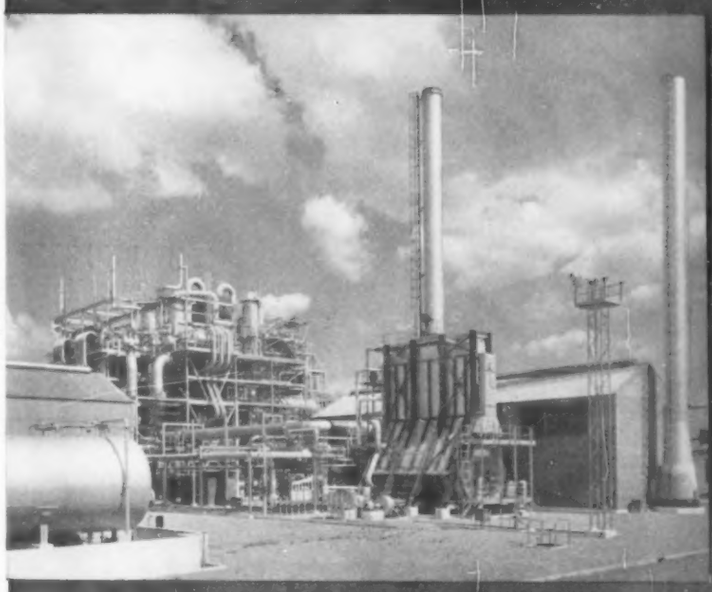
Kellogg Engineers and Builds World's Biggest Olefin Plants



Mobil

FUTURE WORLD'S LARGEST is Socony Mobil Oil Company's ethylene plant at Beaumont, Texas. It is the first large plant in the U.S. to crack naphtha into olefins. Engineered by The M. W. Kellogg Company, as shown in this scale model, it is scheduled for completion by Kellogg by 1961. Capacity will be 380 million pounds annually of 99.9% purity ethylene.

This newest plant consists of steam pyrolysis, gas treating, and product recovery sections. It has been designed to handle simultaneously both liquid and gaseous feedstocks. In addition to ethylene, major products will include propylene, propane, a B-B product, gasoline, and fuel oil.



ICI

LARGEST OUTSIDE THE U.S. is the English Wilton Works of Imperial Chemical Industries, which now includes three olefin plants. Photograph shows Plant No. 3. All are the result of close engineering cooperation between Kellogg and I.C.I. Together, they represent a current output of 110,000 tons per year of high-purity ethylene, and a potential of 140,000 tons.

Plant No. 1, commissioned in 1951, was the first full-scale adoption of the then novel process of oil pyrolysis developed in Kellogg's laboratories. Its success led to the addition of Plant No. 2 in 1956, and then to No. 3—representing a 60% increase in olefin capacity—in 1959.

Whether your approach to ethylene is through the steam pyrolysis of hydrocarbons or the recovery of ethylene from gas mixtures, Kellogg has developed processes which can assure the optimum investment, operating costs, product purity, and yield. For more information about Kellogg's 2-billion-pound background in engineering and/or building ethylene plants, write for a copy of "Olefin Plants" Kelloggram.

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methanol increases sharply with decreasing temperatures. Vapor pressure of methanol at low temperatures is small; after acteylene separation, the residual gas contains only 0.13 grams of methanol per cubic meter; acetylene only 5 mg. Such amounts of the alcohol can be easily removed by silica gel absorption.

Selectivity of methanol is high for diacetylene—the most dangerous component of pyrolysis gases—which allows an easy separation of higher homologs in the first stage of gas cooling, and minimizes the required plant sizes. The high water solubility of methanol permits easy recovery from acetylene in the solvent regeneration step.

The Montecatini plant erected at Novara, Italy, after pilot scale research and development work, has a capacity of 20 ton/day acetylene, used for acetaldehyde and methanol production.

The flow scheme is shown in Fig. 1. Methane and oxygen, separately preheated to 500 C in heat exchangers (1), are sent to the burners (2), where temperature reaches 1500 C; and the flame is quenched by water after about 0.01 seconds. Gas is washed (3) and carbon is filtered out (4). The gas is further cooled (5) and collected in a gas-holder (6). Finally, it is compressed to 13 atm (7), washed with ammonia solution (8-9) to separate CO_2, cooled in exchangers (11-12-14) countercurrently to cold gases from fractionator (18).

Particular attention has been given to complete elimination of dangerous acetylene homologs. Exchangers (11-12-14) are sprayed with methanol; higher boiling alkynes—very soluble—are quickly and completely dissolved, and the solution is regenerated in degassers (13) and (15). Absorption of acetylene in methanol is carried out in column (16) at —70 C; methanol is regenerated by heating at +60 C in still (17). Residual gases are fractionated (18), ethylene being separated first followed by methanol, which is recycled. A mixture of $CO + H_2$ is recovered, in the proper ratio for methanol synthesis, at 13 atm pressure.

Recovery of Heat of Reaction

Results at Novara have shown that through the utilization of byproduct gases for methanol synthesis, the adopted process is a more attractive route to petrochemical acetylene than is the carbide process.

However, the heat balance of the conventional process of partial oxidation of methane is unsatisfactory because the heat content of the gases from the combustion chamber at 1500 C (10 million cal per ton acetylene) is completely lost in water admitted to avoid acetylene decomposition.

A satisfactory technique has been achieved — without impairing acetylene yields—by carrying out the partial oxidation with oxygen at 3 to 4 atm pressure.

Under these conditions and with careful control of the flow of reacting gases, the yield of acetylene is practically unchanged. Further, quenched gases are saturated with water vapor, with dew point above 100 C. It is therefore possible to recover all the heat corresponding to water condensation in the temperature range from saturation to 80 C to regenerate selective solvents employed in acetylene recovery from byproduct gases.

Flow scheme of an acetylene plant operating under pressure is substantially the same as for the atmospheric plant. However, for the same capacity, furnace dimensions are inversely proportional to pressure. High pressure permits the building of units of higher capacity, with noticeable decrease in investment and operating costs.

The design of pressure-operating furnaces presented difficulties connected with flame stability and rapid quenching of reaction products. These have been solved; the first by adding a small percentage of steam to the reactants, the second by improved design of burners and water injection nozzles.

Acetylene from Natural Gas and Petroleum Naphtha

A further development is the combined reaction of methane and higher hydrocarbons (naphtha), which is carried out by injecting a controlled amount of naphtha into the methane flame.

The furnace for this operation is shown in Fig. 2. Methane and oxygen, in the presence of a controlled steam concentration and preheated are fed to the mix chamber (3), pass through the distributor (4), and are reacted in the combustion chamber (5). Thin sprays of vaporized naphtha are injected through the nozzles (6), cracking the naphtha and producing additional acetylene, ethylene, and synthesis gas, at the expense of the heat furnished by the combustion products in the temperature range 1500-800 C.

Gases are further quenched by water injected through the nozzles (7). Water is discharged via pipe (9) while gases leave via pipe (8).

The profile curve at the right in Fig. 2 shows the temperature distribution in the reactor.

The increase in acetylene production obtained by naphtha injection depends upon a series of conditions, among which are naphtha quantity and furnace heat temperature. A comparison of the thermal bal-

(*Continued on page* 112)

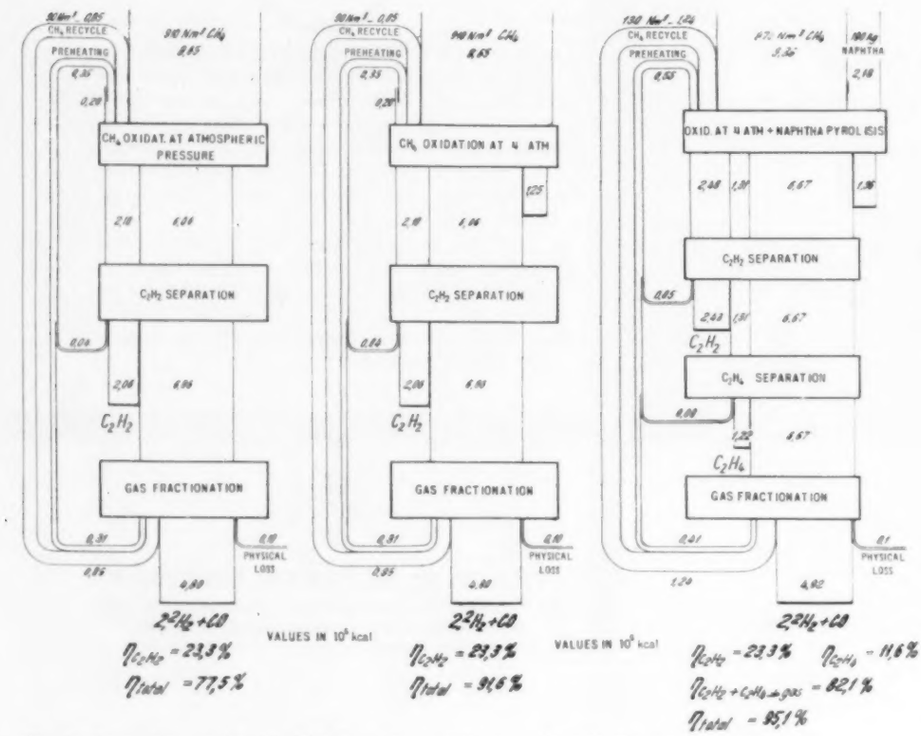


Fig. 3—Comparison of thermal yields from three methane partial oxidation process variations.

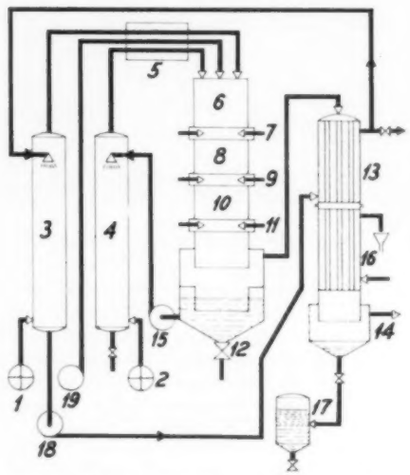
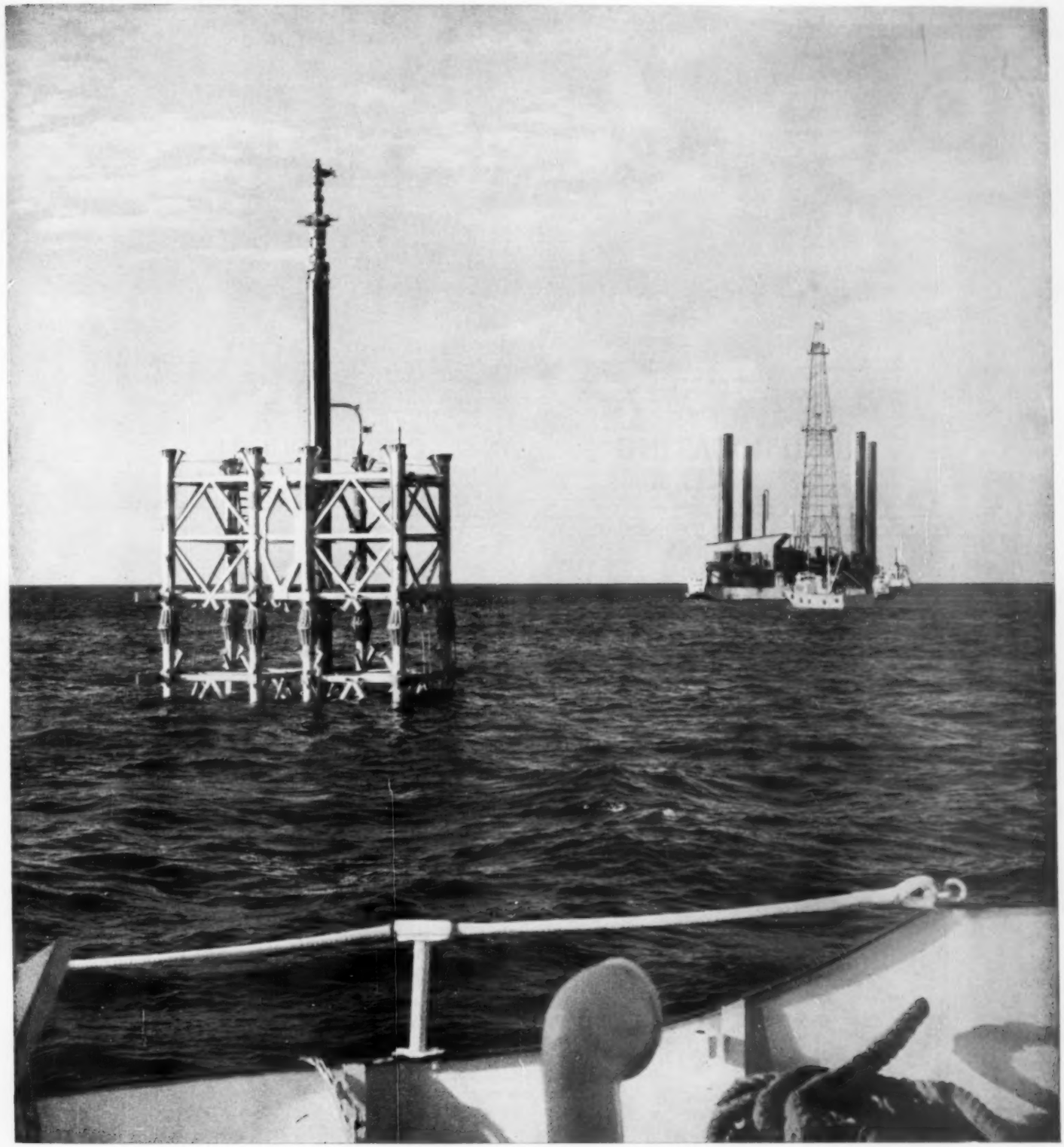


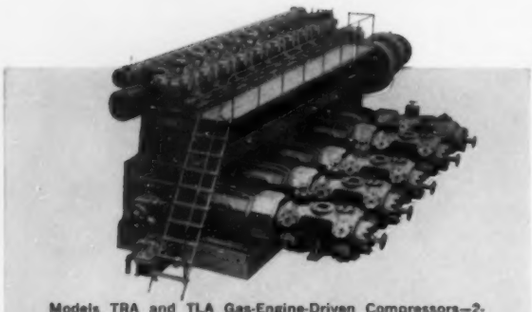
Fig. 4—Plant for production of ethylene and acetylene from petroleum naphtha.



ABU DHABI

A well head on the Persian Gulf. In the background, the barge "Adma Enterprise" which is currently drilling beneath the waters of the Gulf. The results are sufficiently encouraging to warrant the preparation of facilities for regular production. This stage should be reached by mid-1962.

BP



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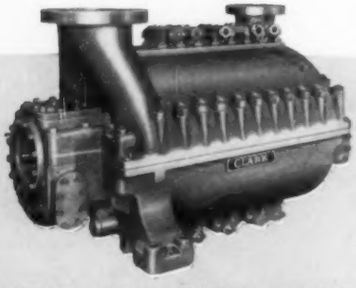

Type HS Horizontally-Split Centrifugal Compressors are highly dependable multi-stage units used extensively in petroleum processing. Seven case sizes are available in capacities ranging to over 150,000 cfm. Up to ten stages of compression in a single case. Cooled or uncooled types available to meet process requirements.

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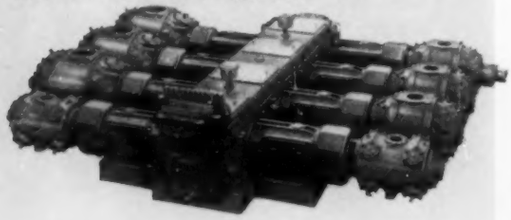
Models CLBA, CLRA, CJA, CMB, CMA and CFA Motor-Driven Compressors for heavy duty process applications. These balanced/opposed compressors are built in seven stroke sizes—6", 8", 8¾", 11", 14", 17" and 19". Available with 2 to 10 compressor cylinders depending on model chosen. Pressures from vacuum to over 36,000 psi.



Type VS Vertically-Split Centrifugal Compressors are multi-stage units designed for extremely high pressures—to over 5,000 psig. Four case sizes have a capacity range from 200 discharge cfm to 20,000 suction cfm. Barrel-like outer case provides maximum strength. Inner case is horizontally split for easy accessibility

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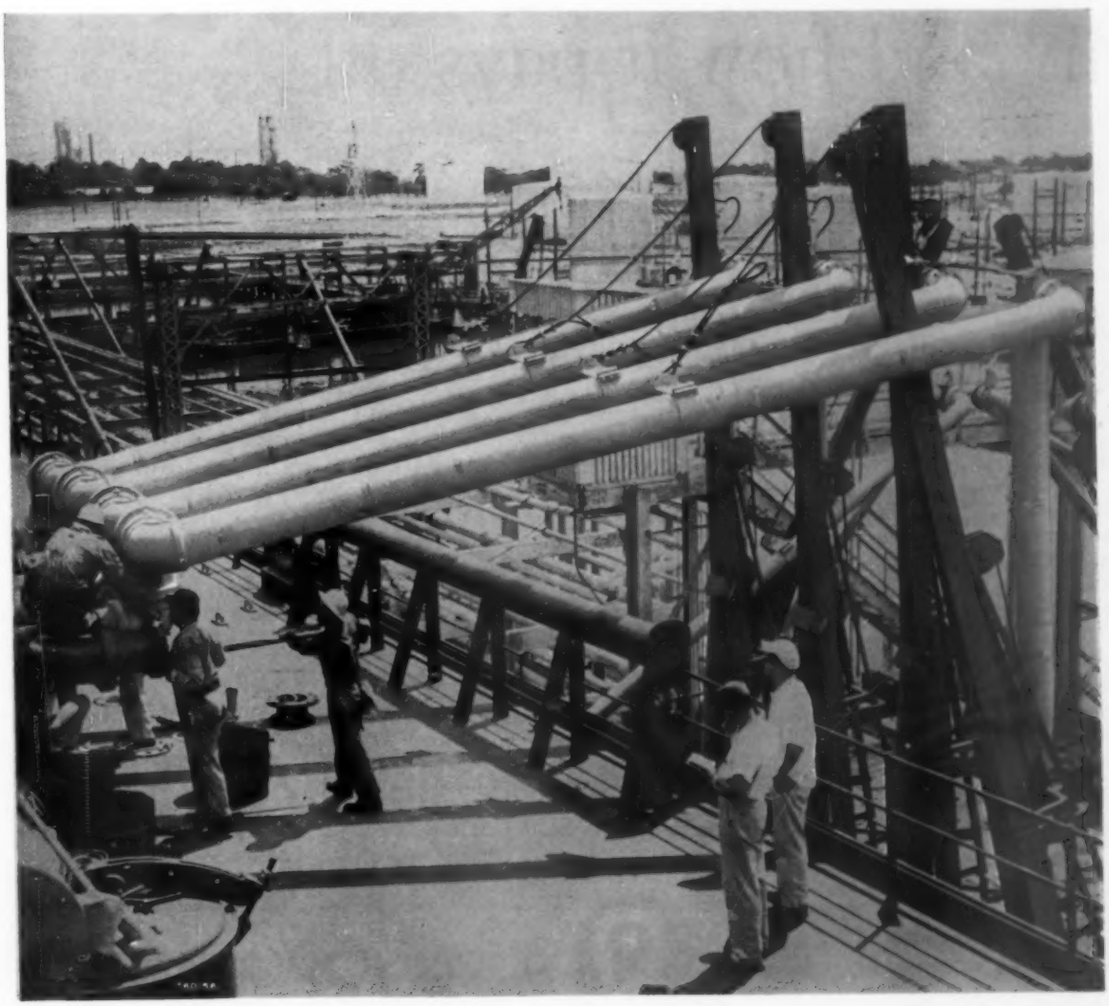
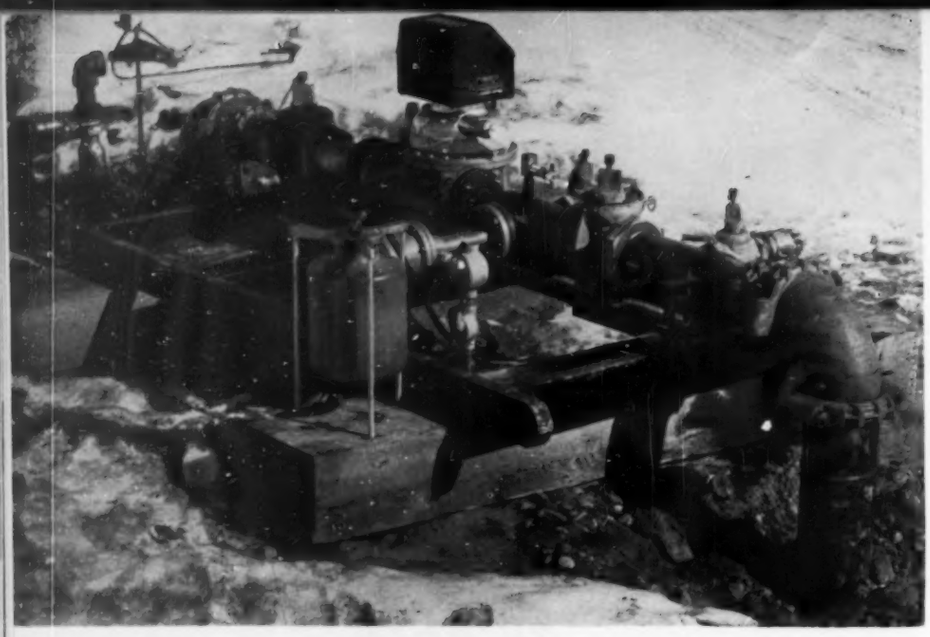




A skid-mounted lease meter unit as installed in the field

by K. H. Kretzschmar and M. A. Smith*

Automatic custody transfer (ACT) — why and how it pays off

Oil field automation by ACT techniques has developed rapidly in western Canada. Based on a very successful operation in the Pembina field, a simple and direct approach is described, with suggested terms of agreement between producer and pipeline operator which can be successful in virtually any location

OILFIELD AUTOMATION in western Canada in the form of automatic custody transfer (ACT) has grown phenomenally, from a single installation at the end of 1955 to more than 120 at the end of 1959. And present indications are that as many as 100 more will be made during 1960.

It is the purpose of this article to suggest and describe a simple and orderly approach to designing an ACT installation.

A good ACT installation will have four attributes: accuracy, reliability, low cost and flexibility.

Flexibility: volume measurements of crude transfers must be at least as accurate as gauging. A well designed ACT installation using positive displacement meters can attain a standard of accuracy substantially higher than that of the conventional, manual gauging method of transfer.

Reliability is a function of design and choice of components. Keep the basic design as simple as possible, consistent with the performance required. Components must be chosen with particular attention to the environment in which they will be used. If these principles are adhered to, the reliability can meet or surpass accepted standards for conventional, manually operated systems.

Low cost is also a function of design. The system must be kept simple. Existing or conventional equipment should be used as much as possible. Unnecessary features and accessories should be avoided and used only when a definite need exists. The days are gone when ACT could be installed on an experimental basis without regard to a return on investment.

Flexibility: ACT must be designed for specific operating conditions yet be flexible enough to allow a nominal departure from design conditions. It must provide a reasonable safety factor to tide operations over temporary equipment failures, pipe line shutdowns, and related emergencies.

Basic Design Criteria

ACT installations have been classified two ways, for purposes of this article: Class I, where production is essentially continuous on a 24 hour/day basis, and Class II, where production occurs over intervals of less than 24 hours/day. These two classes have been further divided into two categories: (1) where produced oil is of pipe line quality, and (2) where produced oil is wet and must be dehydrated before shipping.

Design of an ACT installation requires a number of basic assumptions. For Class I installations, these assumptions are:

1. Transfer conditions. The pipe line must be able to, and must agree to, accept transfers on a non-scheduled basis. If this condition cannot be met, the chief benefits of ACT will not be realized, either by the producer or the pipe line operator.

Frequency of transfers will be governed by Points 6, 7, and 8 below; i.e., the pipe line pump will be on 4 hrs and off 4 hrs if average producing rates are maintained.

2. Volume measurement. The reliability and accuracy of rotary positive displacement meters has been well proved.

3. Tankage. To make ACT attractive to the producer, tankage requirements must be reduced to a practical minimum. In new installations, this results in equipment and construction cost savings. In conversions of

*Messrs. Kretzschmar and Smith are associated with Mobil Oil of Canada Ltd., Calgary, Alta. This article is an adaptation of their paper "Suggested Criteria for the Design of Automatic Custody Transfer Installations," presented at the May meeting of the Canadian Institute of Mining and Metallurgy in Calgary.

existing installations, it results in operating savings through the reduction of total heating requirements, vapor and heat losses, and tank maintenance. Surplus tankage would also be available for resale.

4. Reserve storage capacity. It is assumed that personnel will be available during daylight shifts only, to spot-check the performance of any given ACT battery. Thus, for 16 hr out of each 24, unattended operation will prevail. Reserve storage capacity should be sufficient therefore to permit continuous production throughout this period, even though ACT may have been interrupted.

5. Weathering. To prevent volume shrinkage of crude oil in the pipe line system, all production should be weathered prior to transfer. This can be accomplished by preserving a relatively undisturbed cushion of oil above the shipping tank outlet. The volume of this cushion, expressed in terms of pumping time for the pipe line pump, is synonymous with weathering time. For the general case, a three hour cushion should be sufficient. "Problem" crudes may require longer weathering periods.

6. Pipe Line Pump Capacity should be double the average producing rate for the lease. This excess is required to handle periods of abnormal production, to catch up after interruptions in custody transfer, and to equalize on-off periods for the pump.

7. Pump Operating Periods. In order to equalize the load on the pipe line system and the electric power supply system, on and off periods for the pipe line pump should be equal. This helps to establish a more random starting and stopping pattern as the number of ACT installations in a given gathering system increases.

8. Frequency of Shipping. To minimize heat losses and to eliminate the necessity for intank heating facilities, the maximum off period for custody transfer should not exceed 4 hrs. This also helps to prevent possible meter errors by reducing the range of crude oil temperatures for which the meter must compensate.

9. BS and W Monitor Location. Wet oil must never be allowed to reach the R and S (receiving and shipping) tank, because this would halt all transfers to the pipe line. Production would probably have to be shutin to enable the R and S tank contents to be recycled through the treater. For this reason, the BS and W monitor must be installed upstream from the R and S tank. Wet production can then be diverted to a slop tank for later recycling as conditions permit.

10. Slop Tank Storage Capacity. The remarks made under Point 4 apply in this case also.

11. Monitoring of Shipping Temperatures. A temperature sensing element in the R and S tank adjacent to the outlet will continuously monitor the oil temperature. If this falls below the pipe line acceptance level, a switch and associated relays will stop the transfer pump.

For Class II installations, these are the assumptions: *(Continued on page 84)*

AVG. PRODUCING RATE, B/D	REQUIRED P.L. PUMP CAPACITY, B/hr.	REQUIRED VOL. FOR WEATHERING, bbls.	REQUIRED VOL. FOR WORKING INTERVAL, bbls.
100	8.33	25	16.67
200	16.67	50	33.33
300	25	75	50
400	33.33	100	66.67
500	41.67	125	83.33
600	50	150	100
700	58.33	175	116.67
800	66.67	200	133.33
900	75	225	150
1000	83.33	250	166.67
1100	91.67	275	183.33
1200	100	300	200
1300	108.33	325	216.67
1400	116.67	350	233.33
1500	125	375	250
1600	133.37	400	266.67
1700	141.67	425	283.33
1800	150	450	300
1900	158.33	475	316.67
2000	166.67	500	333.33

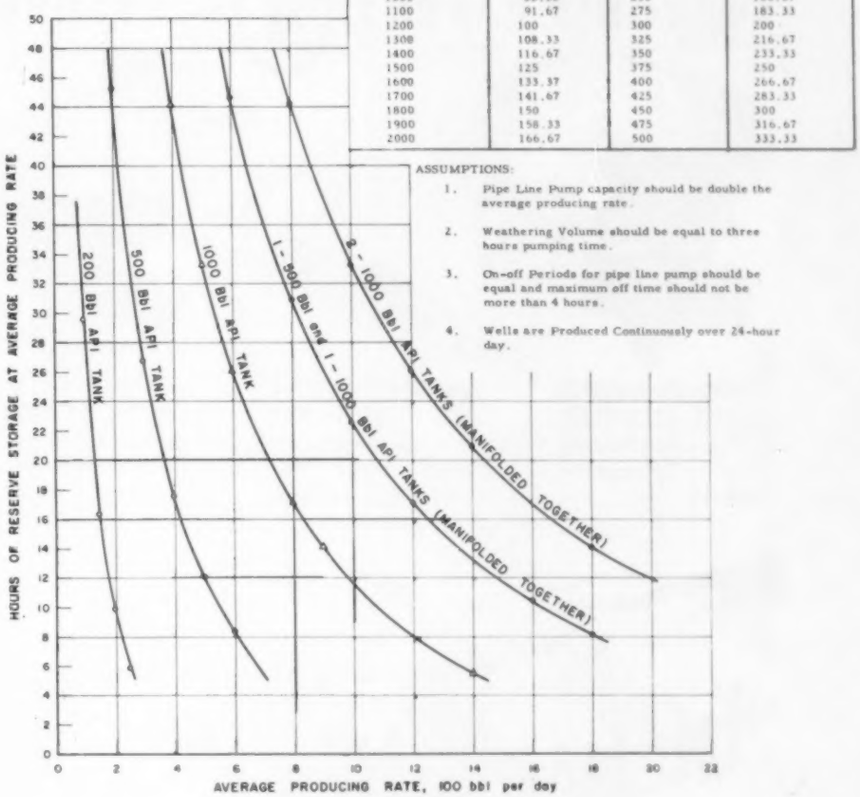
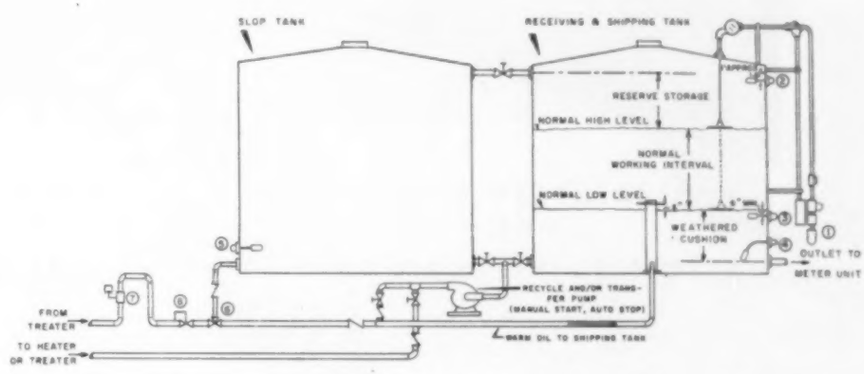

ASSUMPTIONS:
1. Pipe Line Pump capacity should be double the average producing rate.
2. Weathering Volume should be equal to three hours pumping time.
3. On-off Periods for pipe line pump should be equal and maximum off time should not be more than 4 hours.
4. Wells are Produced Continuously over 24-hour day.
200 Bbl API TANK
500 Bbl API TANK
1000 Bbl API TANK
1 - 500 Bbl and 1 - 1000 Bbl API TANKS (MANIFOLDED TOGETHER)
2 - 1000 Bbl API TANKS (MANIFOLDED TOGETHER)
HOURS OF RESERVE STORAGE AT AVERAGE PRODUCING RATE
AVERAGE PRODUCING RATE, 100 bbl per day

Fig. 1—Class I installations: wells producing continuously over 24-hr day



LEGEND
1. Normal Working Interval Level Control: - Starts and stops pipe line pump, lights indicator lights on panel
2. Emergency High Level Float Switch: - Actuates alarm signal, starts pipe line pump, lights indicator light on panel
3. Emergency Low Level Float Switch: - Actuates alarm signal, stops pipe line pump, lights indicator light on panel
4. Temperature Control Switch: - Oil temperature below set point stops pipe line pump
5. Low Level Float Switch: - Stops transfer pump on slop tank
6. 3-Way 2-Position Motor Valve: - Diverts wet oil to slop tank on signal from BS&W monitor, actuates alarm, lights indicator light on panel
7. BS&W Monitor: - Actuates diverting valve (6)
8. Back Pressure Valve

Fig. 2—ACT where wells produce wet oil (single tank plus slop tank)

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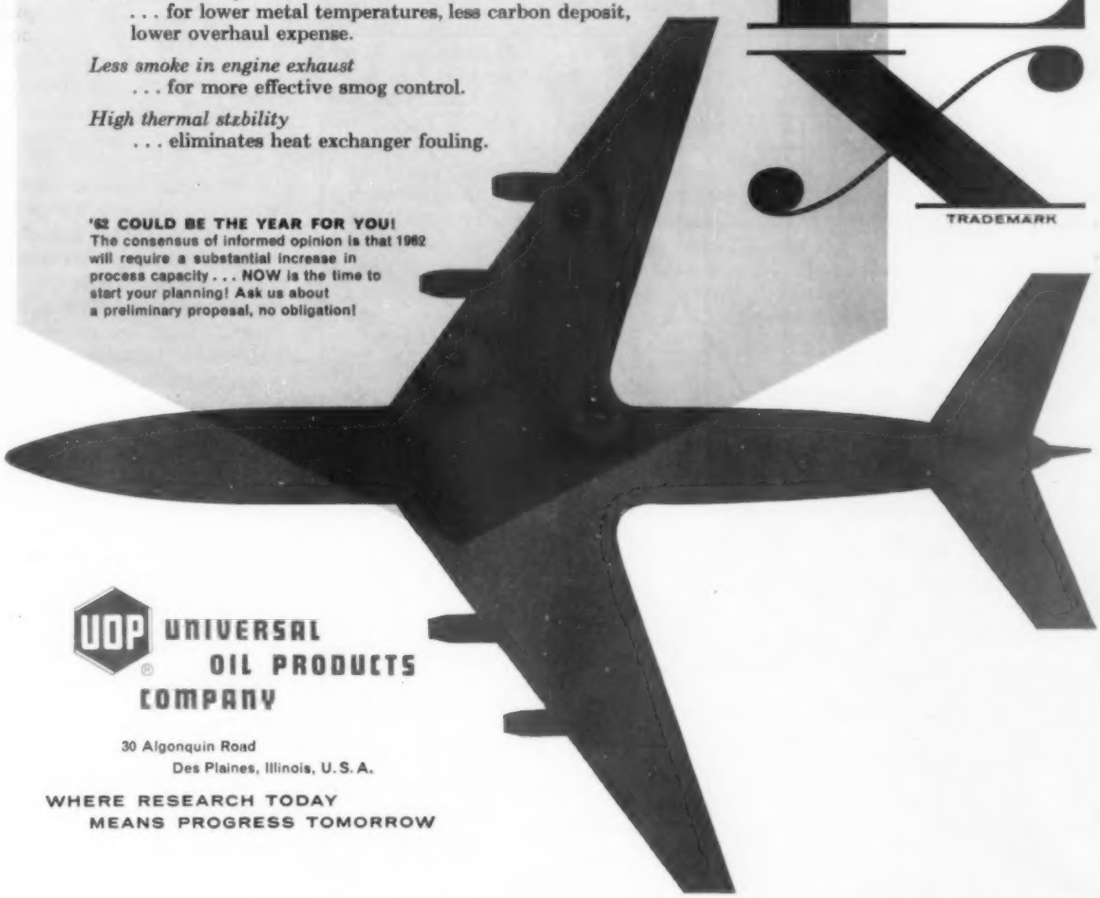

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1. Transfer Conditions. Crude oil transfers to the pipe line may be on a scheduled basis. The schedule must conform to the following stipulations: (a) the transfer pump will start one hour after production begins, (b) the transfer pump will stop not more than 4 hrs after production stops.

The first stipulation provides a reasonable period of time for the battery operator to make sure his equipment is functioning properly. The second stipulation insures, under most conditions, that the oil will not cool to below pipe line acceptance level, and at the same time, allows the pump and prime mover to be sized on a conservative basis.

2. Pipe Line Pump Capacity will be governed by the duration of the producing interval, producing rate, and stipulations of the above paragraph.

3. Reserve Storage Capacity in the R and S tank must be equivalent to one full day's production, unless automatic lease shut-in facilities are provided. Where production is wet, the slop tank storage capacity must also be equivalent to one day's production.

It is assumed that the battery will be attended only for brief periods at the beginning and the end of each day's producing interval. Unless automatic shut-in facilities are provided, reserve storage capacity must obviously be sufficient to accommodate one day's production.

4. Volume measurement, weathering, BS and W, and temperature monitoring requirements are as outlined above for Class I installations.

Typical ACT Designs

To illustrate how the foregoing assumptions are used to develop a typical design, one example for each class of installation is given below.

Class I installation, with an average producing rate of 800 b/d, or 33.33 bbl/hr.

Required pipe line pump capacity is double average producing rate, $2 \times 33.33 = 66.66$ bbl/hr.

Weathering volume is three times pipe line pump capacity, $3 \times 66.66 = 200$ bbls.

Working interval volume is four times the difference between pipe line pump capacity and average producing rate, $4 \times (66.66 - 33.33) = 133.32$ bbls.

Try a 1,000-bbl R and S tank (useable volume is 903 bbls). Net active volume available is difference between useable volume and weathering volume, $903 - 200 = 703$ bbls. The reserve storage volume is the difference between net active volume and working interval volume, $703 - 133.32 = 569.68$ bbls.

Check by dividing reserve storage volume by producing rate, $569.68 \div 33.33 = 17.1$ hrs of production.

Therefore, a 1,000-bbl, API tank will be satisfactory as the R and S tank. Level controls must be positioned in accordance with the results obtained above.

The same results may be obtained without making these calculations. Refer to Fig. 1. Schematic layouts of the R and S tank assembly are shown in Figs. 2 and 4.

Class II installation, with an average producing rate of 400 bbls in six hrs, or 66.67 bbl/hr.

Required pipe line pump capacity is equal to the daily production divided by the sum of the producing hours plus 4 hrs minus 1 hr, $400 \div 9 = 44.44$ bbl/hr.

Weathering volume is three times pipe line pump capacity, $3 \times 44.44 = 133.32$ bbls.

Working interval volume equals one hour's production, $400 \div 6 = 66.67$ bbls.

Try a 1,000-bbl R and S tank (useable volume 903 bbls). Net active volume available is difference between useable volume and weathering volume, $903 - 133.32 = 769.68$ bbls. The reserve storage volume is difference between net active volume and working interval volume, $769.68 - 66.67 = 703$ bbls.

Therefore, a 1,000-bbl, API tank will be satisfactory as the R and S tank, because its reserve capacity is in excess of one day's production.

The required pipe line pump capacities and R and S tank sizes for various producing rates and periods are shown in Fig. 3. Schematic layouts of the tank assembly are in Figs. 2 and 4.

A typical ACT metering unit consists essentially of a temperature compensated rotary PD meter, a solenoid sampler actuated by the meter, and a master meter bypass, all mounted on a small skid base, see Fig. 5. In most cases a strainer is not required, and in a well designed installation an air eliminator is largely unnecessary. Omitting these two items removes the necessity for a charging pump, except in a few cases where flow conditions are unfavorable.

A charging pump should not be used unless there is a definite need for it. Arguments that it contributes significantly to

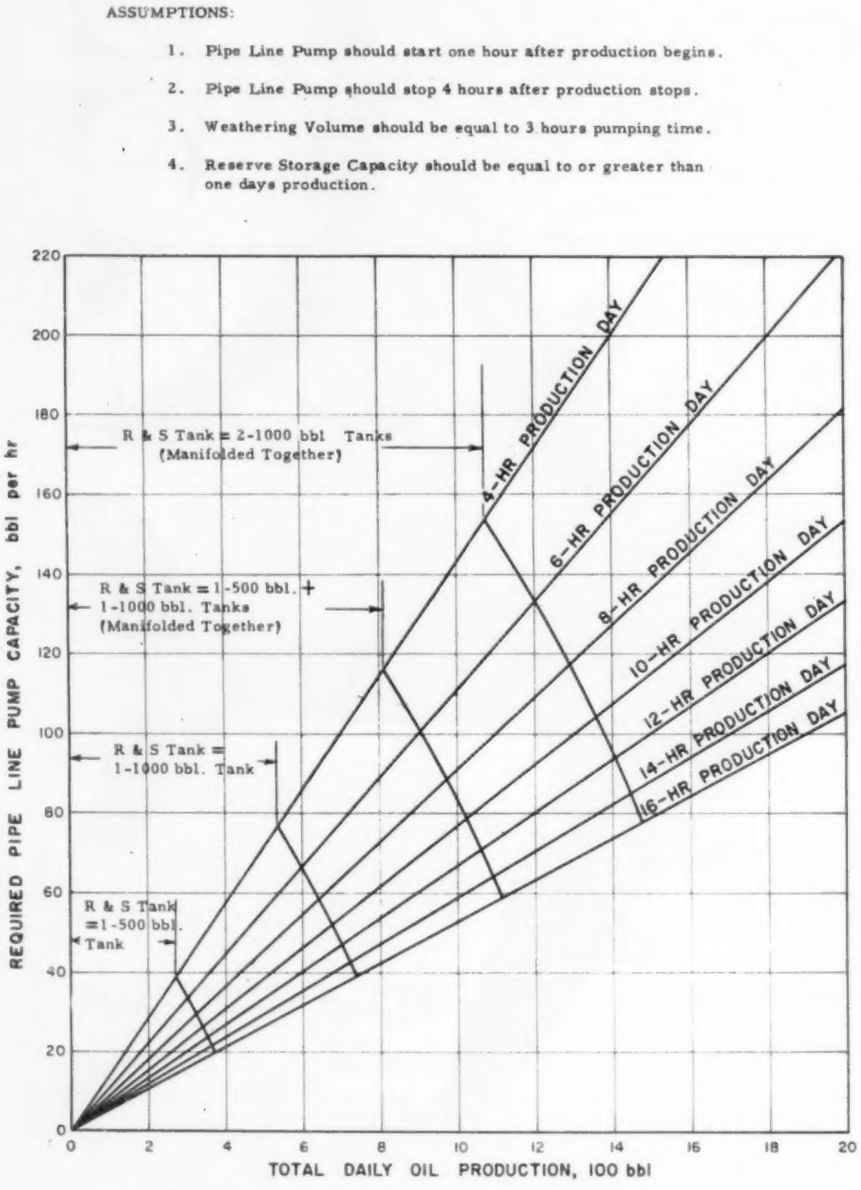

ASSUMPTIONS:
1. Pipe Line Pump should start one hour after production begins.
2. Pipe Line Pump should stop 4 hours after production stops.
3. Weathering Volume should be equal to 3 hours pumping time.
4. Reserve Storage Capacity should be equal to or greater than one days production.
REQUIRED PIPE LINE PUMP CAPACITY, bbl per hr
TOTAL DAILY OIL PRODUCTION, 100 bbl
R & S Tank = 2-1000 bbl Tanks (Manifolded Together)
R & S Tank = 1-500 bbl. + 1-1000 bbl. Tanks (Manifolded Together)
R & S Tank = 1-1000 bbl. Tank
R & S Tank = 1-500 bbl. Tank
4-HR PRODUCTION DAY
6-HR PRODUCTION DAY
8-HR PRODUCTION DAY
10-HR PRODUCTION DAY
12-HR PRODUCTION DAY
14-HR PRODUCTION DAY
16-HR PRODUCTION DAY

Fig. 3—Class II installations: wells producing over intervals less than 24 hrs per day

metering accuracy have not been demonstrated in actual practice. Where a charging pump has been used, it has constituted the greatest single cause of malfunctioning.

Suction connections to the pipe line pump should be as large as practicable. Where pressure surges and associated vibration occur in the metering unit, these can be eliminated by installing a surge chamber on the suction side of the pump.

A simple ACT status and control panel can be considered an optional extra, though it performs a very useful function at batteries served by a flying operator who can spend only a limited amount of time at each site.

Operating History

A typical installation in the Pembina, Alberta, field will serve to illustrate the major considerations for a successful ACT design.

In April, 1958, several conventionally operated batteries were converted to automatic transfer. The stock tanks in place were used. One was designated the shipping, or surge, tank, and the remainder were used for excess emergency storage and wet oil tanks.

A simple, 20-in diameter riser, topped by a spreader plate, was installed in the surge tank; its height calculated so as to allow a cushion of weathered oil, equivalent to 3 hrs pumping time, above the tank outlet. A low level float switch was installed at the top of the weathered cushion, and a high level float switch was placed in the upper part of the tank. The pipe line pump was actuated from these level controls.

The meter unit was a simple, skid-mounted assembly, consisting of a PD meter, solenoid sampler and master meter tie-in. Low shipping temperature cut-out switches were installed in the surge tank to prevent transfer of oil at a temperature below the agreed acceptance limit.

Level controllers with several types of detection devices were evaluated. Where poor voltage regulation and widely varying frequencies occur, certain types are unacceptable, such as those which depend on dampening effects, and hence frequency change, for actuation. In most areas, simple bayonet-type floats with microswitches have proved very satisfactory. The float arm design should be carefully scrutinized where wax encrustation and corrosion are a problem. Capacitance measurement level controls may also be subject to failure by wax deposition.

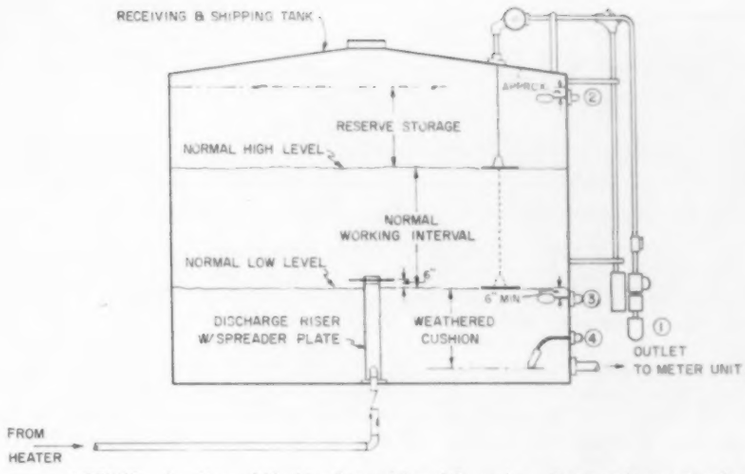
The most flexible installation has been achieved with float-actuated gauges using power driven displacer elements, and having variable level programmers. Sensitivity of this type of instrument is good, and the level intervals are readily variable.

Pembina meter proving practices. The pipe line operator usually proves the shipping meter once each month. Meter proving follows the tentative API Code No. 1101, July, 1946, revised January 1952. Procedure is to hook up a PD meter in series with the lease shipping meter. The pipe line pump is started, and crude oil allowed to circulate through the meters for 15 minutes to give uniform temperatures within the meters. Pump is started again, and allowed to run until approximately 12 bbl of oil have passed through the meters. When the pump has stopped, the closing meter readings are taken.

The amount of oil that has passed through the master meter (difference between closing and opening meter readings) is multiplied by the master meter correction factor to obtain the true volume of oil shipped. To obtain the lease meter correction factor, the true amount of oil shipped is divided by the amount that has passed through the lease meter (difference between closing and opening lease meter readings). Two to four tests are run, until two tests agree to within 0.0005 with the previously used meter factor. If the difference is greater, proving continues until two consecutive runs do agree within 0.0005. The average of these two will be taken as the new meter factor.

The master meter used by the pipe line is usually proved once every week, against a 12-bbl, government tested and approved tank. The tank is very accurately calibrated; it is internally plastic coated and has reduced necks with calibrated gauge glasses. Master meter proving is in accordance with the provisions of tentative API Code 1101.

Performance of lease metering units. The PD meters used for ACT have performed excellently to date. A typical lease meter plot for the last two years, Fig. 6, shows the maximum variation in factors, between provings, has been 0.22%. This occurred at the start-up. Subsequent variations have


RECEIVING & SHIPPING TANK
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NORMAL WORKING INTERVAL
NORMAL LOW LEVEL
6" MIN.
DISCHARGE RISER W/SPREADER PLATE
WEATHERED CUSHION
OUTLET TO METER UNIT
FROM HEATER
LEGEND: 1 Normal Working Interval Level Control: - Starts and stops pipe line pump, lights indicator lights on panel.
2 Emergency High Level Float Switch: - Actuates alarm signal, starts pipe line pump, lights indicator light on panel.
3 Emergency Low Level Float Switch: - Actuates alarm signal, stops pipe line pump, lights indicator light on panel.
4 Temperature Control Switch: - Oil temperature below set point stops pipe line pump.

Fig. 4—ACT where wells produce pipe line oil (single tank assembly)

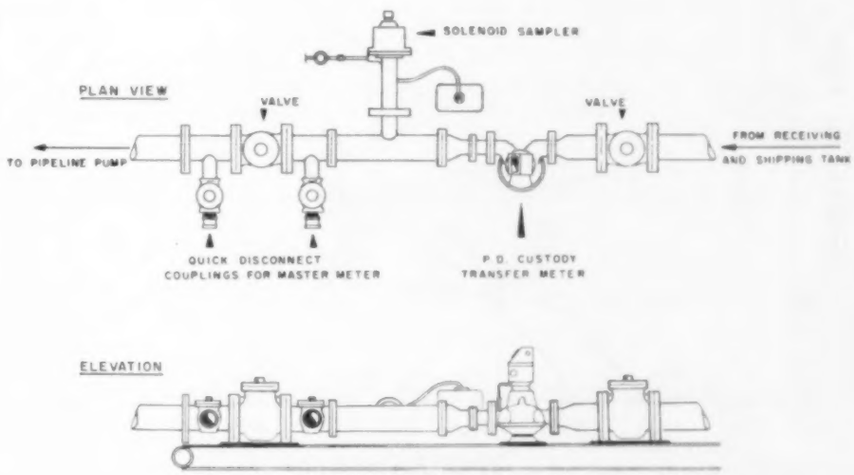

Fig. 5—Typical skid-mounted ACT metering and sampling unit

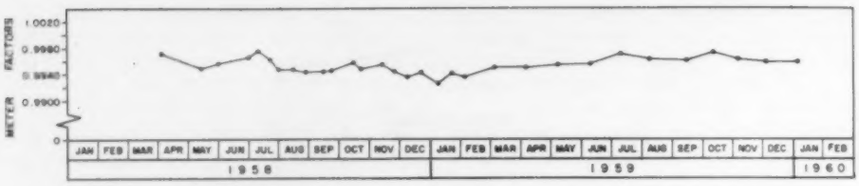

Fig. 6—Typical lease meter factor plot—Violet Grove Battery 31 Pembina field

been a minimum and generally less than 0.1%. These figures compare well with manual gauging, which may produce errors of up to 1.0%, and often considerably more.

The PD meters are temperature compensated. A typical temperature profile for a shipping tank in the Pembina field is shown in Fig. 7. It is apparent from this that in conventional gauging practices, large errors may occur in the computed oil volume regardless of the accuracy of gauging.

The BS and W in the crude stream being shipped to the pipe line is determined from samples taken by a proportional sampler. Solenoid actuated samplers which are connected directly with the oil meters appear to offer the best method of sampling. A flow-proportional signal is generated by a microswitch attached to the meter; this is used to actuate the sampling device.

The only difficulties encountered thus far with ACT have been a slight deposition of wax in the meter proving tank, and pressure losses in the master meter proving hook-up of large throughput batteries.

These have been overcome by regular cleaning of the proving tank, and the installation of a charging pump. An ever present problem, wax, can only be overcome in colder climates by maintaining adequate temperatures in the surge tank and keeping pipe line pump off-time at a minimum. Housing, and possibly some form of heating, of lease metering units is another measure to be considered for extreme cases.

Monitor performance. In areas of water production, it is necessary to install BS and W monitors to detect unacceptable oil and to actuate a suitable diverting valve. Monitors are installed as shown in Fig. 2. The points to keep in mind in such an installation are:

1. Mount plastic coated probe upstream of the treater dump valve. If this is not possible, provide a suitable back-pressure valve to maintain a head on the probe.
2. Do not mount probe horizontally; keep it in vertical position.
3. Flow through the probe should be upward.
4. Pipe runs, valves and fittings should be at a minimum between treater and probe, to prevent pressure losses and subsequent breakout of gas from oil.
5. In-line installation of probes is preferred to a by-pass arrangement with charging pump.

These considerations will help obviate gas breakout and "locking" of the probe, help prevent wax and BS and W deposition, and provide homogeneous flow of water and oil.

Where severe operating and climatic conditions are encountered, the monitor should have the following additional features:

1. Temperature compensation of the probe.
2. Suitable heater to provide favorable ambient conditions for the electronic circuit; oscillator may be temperature sensitive.
3. Close voltage regulation to provide adequate circuit function. Voltage variations of 5% or more, usual in many oil fields, could cause a change in monitor set point of 0.1% BS and W without voltage regulation.
4. The coaxial cable length is often critical. It should be kept as short as possible; and in any case should be suitably insulated where ambient temperatures vary considerably. On 50 ft or more of cable, a 50 F temperature change could cause an 0.1% BS and W change in the monitor setting.

Individually, the possible sources of error listed are not great. However, in western Canada, where agreements call for pipe line oil to contain not more than 0.5% BS and W, their cumulative effects can be very critical.

In general, where BS and W monitors have been properly installed, and where they are suitably calibrated and maintained, they have proved satisfactory for detecting excessive BS and W in the produced oil streams. They are not suitable for accurate, quantitative measurements.

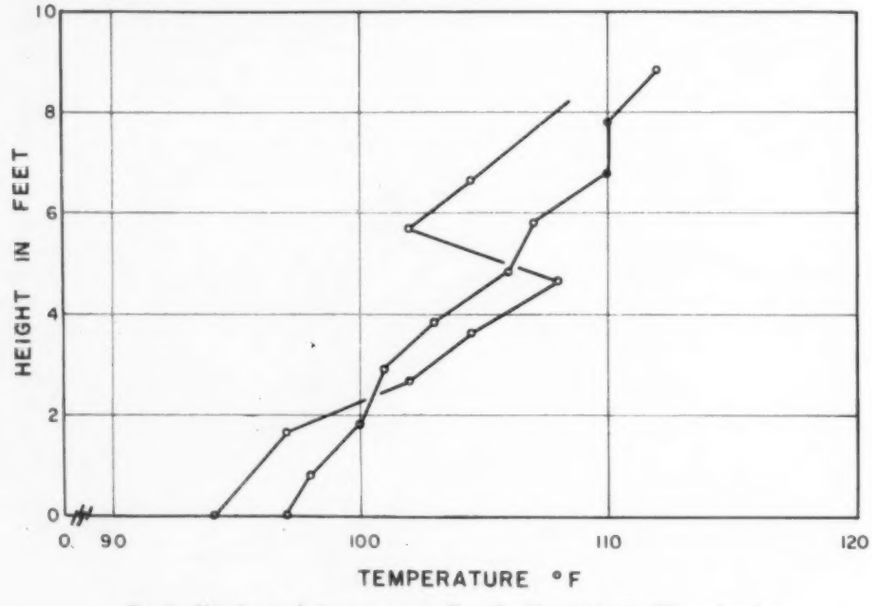

Fig. 7—Shipping tank temperature profiles—Pembina field, 38 API crude oil

Conditions Necessary for Favorable ACT Operation

For ACT to operate to its greatest advantage for both producer and pipe line operator, and for ACT to continue to grow throughout the petroleum industry, co-operation and mutual understanding between the participants must be encouraged. Furthermore, the co-operation of regulatory bodies is necessary for the proper development of ACT.

The rapid growth of ACT in western Canada demonstrates that this co-operation has indeed been obtained.

A logical division of responsibilities and costs between producer and pipe line operator is as follows:

1. Producer is responsible for the installation, operation, and maintenance of all equipment upstream from, and including, the shipping tank outlet valve. This also includes facilities to detect and divert non-saleable oil.
2. The pipe line operator is responsible for the installation, operation, and maintenance of all equipment downstream from the shipping tank outlet valve. This includes metering, sampling, and pumping facilities.

Depending upon the class, category, and throughput of the installation, the pipe line operator's share of the cost could range from 20 to 40% of the total.

Distribution of benefits. Since the producer is required to make the largest investment in an ACT installation, he can expect to derive the greatest savings, and this is probably the case.

Tankage requirements are less for a particular lease throughput, and this saving may often offset the producer's required investment. The reduced investment in

(*Continued on page* 100)

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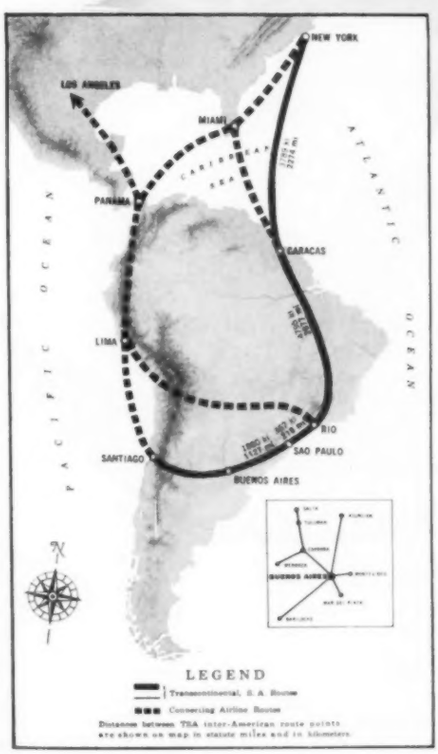

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Review of recent USA patents on hydrazine and substituted hydrazines

by Harold Shalit and Heinz Heinemann

HYDRAZINE is not ordinarily regarded as a petrochemical. However, in its structural relation to ammonia and, in fact, its manufacture from ammonia, it is a chemical truly derivable from petroleum. Until about ten years ago hydrazine and its derivatives were relatively rare compounds, known chiefly as laboratory chemicals. However, the application of hydrazines as high energy fuels for rocket propulsion has provided a stimulus for investigation of these interesting materials which promises to make them increasingly more available and less expensive. It is to be expected, therefore, that more uses will be developed for this class of compounds.

Hydrazine, itself, is a clear liquid melting at 2C and boiling at 113.5C. The commercial method of manufacture is the Raschig Process, carried out as a two-step reaction between chlorine and ammonia in sodium hydroxide solution according to the following equations:

$$Cl_2 + NH_3 + NaOH \rightarrow NH_2Cl + NaCl + H_2O$$
$$NH_3 + NH_2Cl + NaOH \rightarrow NH_2NH_2 + NaCl + H_2O$$

From this process, hydrazine is obtained in dilute aqueous solution; considerable effort is then expended to produce the pure compound, and it is the necessary purification difficulties which serve to increase the price of the product. Other processing problems have made the Raschig method subject to considerable investigation as well as stimulating work on the development of alternative procedures. Besides its utility as a rocket fuel, hydrazine finds application in some miscellaneous areas. It is a powerful reducing agent with the advantage that the product of its oxidation is innocuous nitrogen gas. These properties have been exploited in the use of hydrazine as a metal reducer, reducing agent in photography, and as an oxygen scavenger in boiler feed water preparation. Other applications include its use as a metal chelating agent.

The hydrazine derivative most used at the present time is unsymmetrical dimethyl hydrazine which has attractive properties as a rocket fuel. Hydrazine derivatives are also used in a variety of organic compounds and pharmaceuticals. Typical examples are the series of maleic hydrazides which have found some application as anti-tuberculosis agents.

This patent review will consider mainly those patents relating to hydrazine, its preparation, purification, and uses. Only a few patents relating to hydrazine derivatives have been included to provide an idea of the type of ideas on which people are working.

PREPARATION OF HYDRAZINE

W. E. Hanford (in 2,717,200 to the M. W. Kellogg Co.) proposes a multistep method of hydrazine manufacture. The first step is nitration of an amide such as urea, formamide, acetamide, lauramide, benzamide, etc., with an inorganic oxide of nitrogen, typically nitric acid or nitric oxide, or an organic nitrate. The N-nitro amide thus produced is hydrogenated at 50-400 C and 15-2000 psig with or without a catalyst. Suitable hydrogenation catalysts are those composed of nickel, cobalt, or iron, both supported and unsupported; typical reducing agents are sulfur dioxide and the combination zinc plus mineral acid. The product of the reduction is an acid hydrazide from which hydrazine can be recovered by ammonolysis with anhydrous ammonia at 50-200 C and 200-2000 psig. In 2,717,201, H. J. Passino (also of M. W. Kellogg) suggests a method for hydrazine production comprising the reaction of urea with a carbonyl forming metal, e.g., nickel, iron, cobalt, ruthenium, molybdenum, chromium, tungsten, etc., according to the following equation:

$$n(NH_2\text{-}CO\text{-}NH_2) + Metal \rightarrow NH_2\text{-}NH_2 + M(CO)n$$

The reaction takes place from 40 C to the decomposition temperature of urea, 132-150 C. The preferred metal is nickel; formation of nickel carbonyl allows easy separation of the carbonyl from hydrazine, and recovery of nickel metal by thermal decomposition of the carbonyl.

A different approach is taken by H. E. Gunning and A. Kahn (2,736,693 to the Illinois Institute of Technology). According to these inventors, hydrazine is produced in small quantities by the photolysis of ammonia. However, improved yields are obtained by photolyzing a fast flowing ammonia stream to prevent hydrazine decomposition reactions. The stream should be moving at least 100 cm/sec, and a vaporizable olefin should be present as a hydrogen acceptor, also to prevent hydrazine destroying side reactions. Other conditions are temperatures of —20 to 40 C and light of a wavelength preferably 1849 angstroms. Yields up to 58% are reported by this procedure. Similarly in 2,736,694 (H. E. Gunning and C. C. McDonald also to Illinois Institute of Technology), hydrazine is produced by photolysis of ammonia, but here the reaction is photosensitized by operation in the presence of mercury vapor. The same considerations of flow, temperature, and light wavelength apply here as in the previous patent. According to R. M. Mantell, O. J. Plescia, and R. S. Pratt of M. W. Kellogg Co. (2,753,300) hydrazine is produced by the vapor phase reaction of ammonia photosensitized with nitrous oxide. The temperature for this process is preferably from 15-50 C and the pressure preferably from 1-2 atmospheres. It is necessary to provide positive cooling to —40 C following the reaction within 0.1 seconds, this to remove "activation energy" and condense hydrazine.

In 2,767,057 (R. M. Kennedy to Sun Oil Co.) hydrazine is produced by the thermal decomposition of an alkyl aromatic hydrocarbon, preferably toluene, in the presence of a large excess of anhydrous ammonia. The excess of ammonia may range from two to twenty-fold; other conditions are 500-1000 C (preferably 600-800 C), 1-1000 psig (preferable 200-500 psig), and contact times ranging from 0.1 seconds to 10 minutes. J. Robell in 2,779,660 (to Guggenheim Brothers) passes ammonia into a flame, cooling the effluent rapidly to recover hydrazine. The ammonia is introduced at such a rate to give a flame contact time substantially less than 0.01 seconds; the ammonia temperature should be substantially below the flame temperature; and there should be a large excess of ammonia. In a variation of this procedure Robell (2,779,661) suggests that hydrazine is produced by burning a fuel to make hot gases which issue as a jet into the reaction chamber. A stream of ammonia is directed at right angles to the jet and at high velocity. The issuing gaseous product contains hydrazine and is cooled rapidly to stabilize this compound. The contact time of ammonia in the hot zone should be less than 0.01 seconds and its temperature should be less than that of the flue gases. Finally, the ammonia should be in excess of that required for reaction to provide a cooling effect.

In 2,849,356, J. P. Manion of the Olin Mathieson Chemical Corp. proposes to make hydrazine from ammonia by electrical excitation in a glow discharge apparatus at pressures ranging from 3-50 millimeters of mercury absolute. A variation of this process is patented by J. C. Devins and M. Burton, also of the Olin Mathieson Corp. in 2,849,357.

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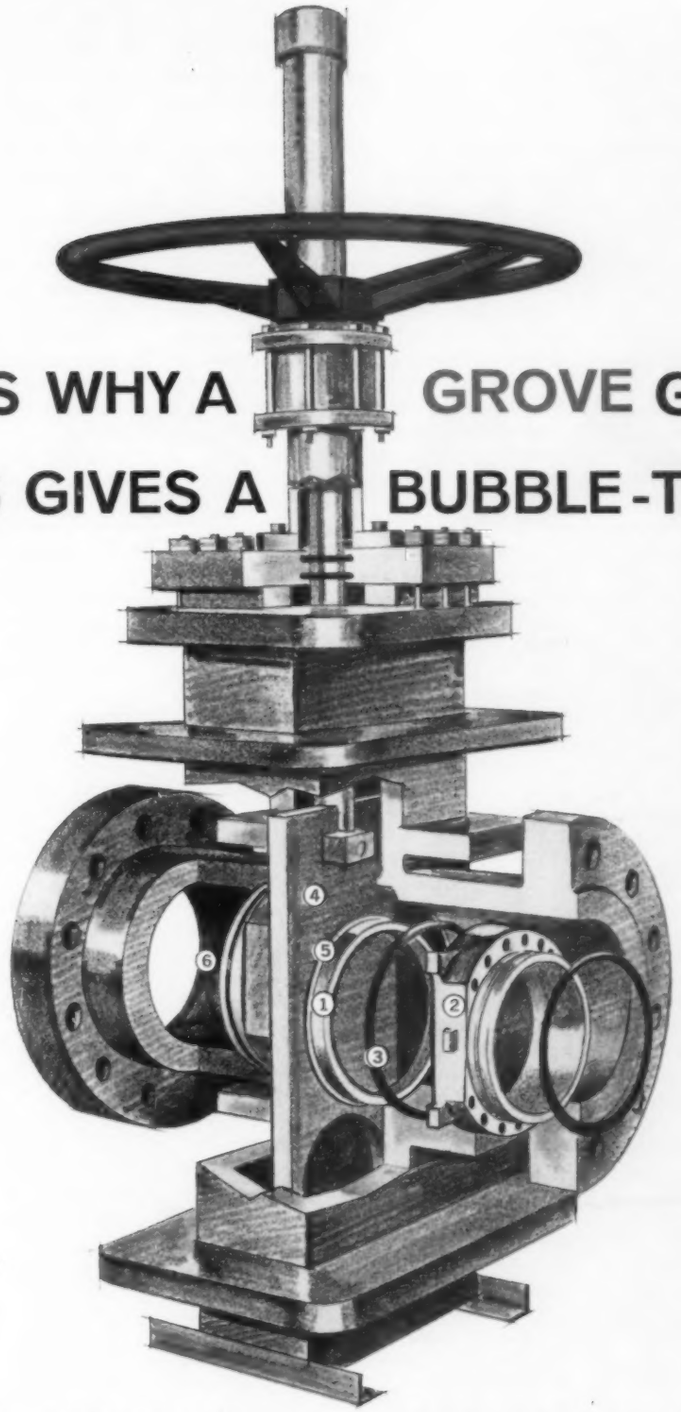

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Robert Cort & Son, Ltd., Reading, England

These inventors subject ammonia to a glow discharge at the same pressures as above but in the presence of platinum metal at the region of positive glow and at a current density of 0.6-6 milliamperes per square centimeter.

An interesting reaction sequence is proposed by H. J. Passino (2,768,878 to the M. W. Kellogg Co.). This involves nitrosation of hexamethylenetetramine to dinitrosopentamethylenetetramine by means of nitrous acid. This product is then hydrogenated at 10-200 C and 15-1000 psi, the preferable ranges being 25-100 C and 100-500 psi. The hydrogenation may be catalytic using such catalysts as nickel, platinum, palladium, iron, or cobalt; or such hydrogen generating systems as zinc plus hydrochloric acid may be used. Using another nitrosation technique, R. M. Mantell and O. J. Plescia in 2,776,190 (to the M. W. Kellogg Co.) react a tertiary olefin with a nitrosating agent such as NO_2, NO, or N_2O_3 at —140 to 200 C. The product is a monomeric nitrosonitrate addition compound. This is then dimerized at temperatures below room temperature to give a bimolecular compound, which is then hydrogenated at superatmospheric pressure producing hydrazine.

A. J. Deutschman and W. C. Bull of Spencer Chemical Co. in 2,803,523 react semicarbazide (or a salt of semicarbazide) with a 10-20 fold excess of ammonia to produce hydrazine, either anhydrous or hydrated. The temperatures employed are 50-200 C. It is claimed that this process overcomes the disadvantage of having product hydrazine in a dilute solution. The same inventors in 2,803,524 make hydrazine by reacting aminoguanidine with excess liquid ammonia at 75-175 C. The ammonia should be in ten-fold molar excess. These are produced in the reaction hydrazine and guanidine; the latter may then be converted to aminoguanidine for reuse.

J. F. Haller and T. H. Dexter (2,805,129 to the Olin Mathieson Chemical Corp.) use the reactants of the Raschig process, chlorine and ammonia, to manufacture hydrazine. They react in a first stage chlorine, diluted at least 5 to 1 with inert gas, with an excess of ammonia, 10-50 moles per mole of chlorine, at temperatures below 100 C. The mixture is then cooled strongly to condense ammonia and chloramine, and ammonia is added to bring the ammonia-chloramine ration up to 100-500. Hydrazine is then produced from this mixture by heating to 25-100 C for less than 0.5 hours and maintaining the pressure at 50-500 psig. In 2,863,728 (H. H. Sisler and R. S. Drago to the Ohio State University Research Foundation) some variations on the Raschig procedure are proposed. The reaction between aqueous amamonia and chloramine is carried out by adding to the ammonia solution glue, gelatine, etc., and an alkali metal hydroxide. Chloramine is then added to the solution maintaining a large excess of ammonia and a slight excess of the hydroxide, this latter condition is said to improve the yields.

In 2,813,067, A. P. Stuart of the Sun Oil Co. produces hydrazine by electrolyzing a solution of alkaline earth amide in dimethyl formamide. The hydrazine separates at the anode, metal at the cathode. Ammonia is then reacted with the alkaline earth metal to produce more amide for recycle to the electrolysis. J. F. Haller, on the other hand, in 2,841,543 (to the Olin Mathieson Chemical Corp. electrolyzes a solution of liquid am*monia* containing dissolved electrolyte. A porous metal anode is used, e.g., stainless steel, nickel, gold, platinum, or carbon with the solution being forced through the anode. A potential is applied to the cell sufficient to repel cations at a velocity greater than the flow rate of the solution. Suitabe electrolytes suggested in the patent are sodamide, sodium hydroxide, water, and ammonium salts.

RECOVERY AND PURIFICATION OF HYDRAZINE

In the production of hydrazine from anhydrous ammonia and chlorine a solution is obtained of hydrazinium chloride and ammonium chloride in liquid ammonia. F. T. Neth (2,735,752 to the Ohio State University Research Foundation) proposes to separate the hydrazine by treating this solution with an alkali or alkaline earth metal dissolved in liquid ammonia. The following typical reactions take place:

$$Na + NH_4Cl \rightarrow NaCl + NH_3 + \tfrac{1}{2}H_2$$

$$Na + N_2H_5Cl \rightarrow NaCl + NH_2\text{-}NH_2 + \tfrac{1}{2}H_2$$

Anhydrous hydrazine may now be recovered readily from this solution by distillation. Another solution to this problem is proposed in 2,899,364 by H. H. Sisler and F. R. Hurley also of the Ohio State University Research Foundation. They continuously distill the liquid ammonia solution at temperatures below 130 C to remove overhead the equilibrium vapors of hydrazine and ammonia. These vapors are condensed and fractionated to separate hydrazine from ammonia, the latter being recycled to the first distillation.

According to 2,799,631 (F. Von Hessert and C. J. Kish to Fairmount Chemical Co., Inc.) hydrazine is recovered from a dilute solution containing salts by flowing the solution into a boiling, aqueous caustic mixture at 125-150 C. Hydrazine is flashed off and recovered. H. Osborg in 2,785,052 assigned to Metalectro Corp. recovers hydrazine from aqueous solution by reacting the solution with calcium carbide carried in an inert, organic liquid. Anhydrous hydrazine is liberated as water is converted by the carbide. Osborg proposes in 2,917,369 (to National Distillers & Chemical Corp.) to extend this process, including alkali or alkaline earth carbides in his list of possible reactants.

As one step in the Raschig process, hydrazine is sometimes recovered as hydrazinium sulfate; anhydrous hydrazine is then evolved by ammonolysis of the sulfate with anhydrous ammonia. B. H. Nicolaisen (2,783,130 to Olin Mathieson Chemical Corp.) proposes to react the ammonium sulfate thus produced with an aqueous solution of hydrazine until all the solid dissolves. This solution is then distilled to recover anhydrous ammonia overhead and an aqueous hydrazinium sulfate solution as bottoms. Water is flashed from this latter material, and anhydrous hydrazine recovered by ammonolysis.

Anhydrous hydrazine can be recovered by the thermal decomposition of its salts in the presence of an anhydrous alcohol solvent. An improvement is suggested by J. Robell, M. Steinberg, and E. B. Jones (2,865,714 to Guggenheim Brothers—1949 Firm), comprising the use of a complex of hydrazine and carbon dioxide as the thermally decomposed compound. Those complexes suggested are carbazic acid, hydrazinium carbazate, and their mixtures. The same inventors, in 2,878,103, separate hydrazine from its aqueous solutions by first reacting the solutions with carbon dioxide to form the carbonate. Water is vaporized off, and the carbonate is treated with alcohol to extract anhydrous hydrazine. An improvement in this procedure consists in first partly decarbonating the salt at 140-141 C, forming an azeotrope containing an excess of hydrazine over carbon dioxide. Anhydrous hydrazine is now more readily extracted with alcohol.

In three patents, 2,773,813-814-815, B. H. Nicolaisen of the Olin Mathieson Chemical Corp. suggests procedures for the use of aniline to azeotrope water from aqueous hydrazine solutions, producing anhydrous hydrazine. Actual conditions for the distillation are set forth as well as methods for recovering hydrazine from the resulting hydrazine-aniline mixtures.

R. N. Lewis (2,780,531 to the Olin Mathieson Chemical Corp.) patents an extraction process for the recovery of hydrazine from its solutions. The process comprises mixing with the solution an organic acid having an ionization constant less than 1.3×10^{-10} at 25 C, e.g., phenols. The hydrazine-acid layer may now be separated from the aqueous layer by decantation. Again, Lewis in 2,785,113 prepares anhydrous hydrazine by distillation of the aqueous solution with a phenol, for example, meta cresol.

MISCELLANEOUS HYDRAZINE PATENTS

For many of its uses, and especially for its use in rocket fuel, it is necessary that hydrazine mixtures have freezing points much lower than that of pure hydrazine, 2 C. D. W. Ryker (2,768,888 to the Olin Mathieson Chemical Corp.) has found that mixtures of guanidine nitrate and hydrazine have substantially lower freezing points than does hydrazine alone. A eutectic composition is formed between these two compounds containing 27.5 parts of guanidine nitrate and melting at —33 C. W. A. Shulze of the Phillips Petroleum Co. in 2,934,417 claims that hydrazine compositions having high heats of combustion and melting below —60 C can be made from mixtures of hydrazine and hydrogen sulfide. The mixtures should have a hydrazine-H_2S weight ratio of 8.7 to 1 and contain not over 25 wt-% water.

According to J. F. Haller (2,837,410 to

(*Continued on page 100*)

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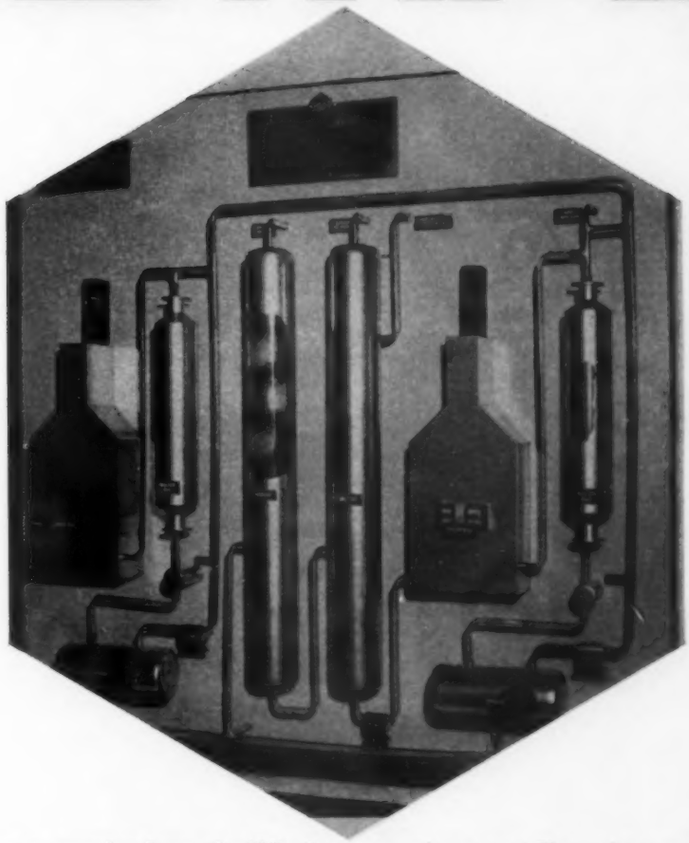

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WHERE RESEARCH TODAY MEANS PROGRESS TOMORROW

by William C. Uhl
Processing Editor

Highlights of the month — a complete review of the technical papers on reforming catalysts from the Second International Congress on Catalysis in Paris

Because of the importance of the subject, this month's world processing review has been devoted to a continuation of the review of significant papers from the Second International Congress on Catalysis in Paris last summer.

The following, covering the nature of reforming catalysts was prepared by Ernest Solomon, associate director of research, The M. W. Kellogg Co. Dr. Solomon's previous article on the Congress appeared in the August, 1960, issue on page 52.

The science of catalysis had made slow and painful progress. We are still far from understanding the detailed mechanisms of even the simplest reactions.

In the case of naphtha reforming catalysts, it appears that there is considerable disagreement even as to the chemical identity of the catalytic agent. At $13 per pound, it might be thought that we could be assured as to what we have in our reactors. On the other hand, the *art* of catalysis has made great strides. Cracking, reforming, alkylation, polymerization, and desulfurization are a few of the catalytic processes which have revolutionized the petroleum industry in the past several decades.

State of Platinum in Platinum-Alumina Catalysts. Mills, Weller and Cornelius (Houdry) and McHenry, Bertolacini, Brennan, Wilson and Seelig (Standard of Indiana) presented papers on this subject. The Houdry team concentrated its attention on the catalyst during regeneration and reduction steps, the Indiana team on the state of the platinum during the reaction cycle. Both dealt with catalysts prepared by reduction with hydrogen of chloroplatinic acid on an alumina support.

The descriptions resulting from the two studies are strikingly different. The Houdry group considers that the platinum is distributed about the surface of the alumina as tiny metallic platinum crystallites; this is the strictly conventional view. The Indiana team believes it has demonstrated that a portion of the platinum is chemically bound to the alumina base and has lost its metallic characteristics; this is an unconventional view and, as such, was the subject of much discussion at the Congress.

The Houdry workers elected to characterize the platinum portion of their catalysts by three criteria:

(1) Platinum crystallite size as determined from X-ray line breadth measurements; the platinum was first concentrated by dissolution of the alumina in 40% caustic.

(2) Capacity for chemisorption of carbon monoxide at 0.1 mm Hg. pressure and 25 C.; this is a measure of the area of the exposed platinum surface.

(3) Activity for dehydrogenation, to benzene, of cyclohexane containing 100 ppm sulfur as thiophene.

It was clearly demonstrated that there is an inverse relationship between catalytic activity and platinum crystallite size as determined by X-ray broadening or as inferred from chemisorption data. Conditions leading to growth of platinum crystallites resulted in loss of activity. Various mechanisms for the migration of platinum on the alumina surface were suggested; no conclusion was reached other than that evaporation of metallic platinum was improbable.

The effect of operating variables on the reduction of chloroplatinic acid to platinum was investigated; this was a study of conditions during reduction of fresh reforming catalyst. If reduction is carried out carefully, the platinum is so well distributed that essentially every platinum atom is exposed and available. Heating of catalyst prior to reduction results in loss of activity, possibly through clumping of chloroplatinate ions. Activity is greatest when the catalyst is reduced with hydrogen at atmospheric pressure, reduction at higher pressures causing marked loss of activity. Water vapor present during reduction is particularly detrimental. Sensitivity to water vapor and to reduction pressure can be minimized by prereduction at atmospheric pressure. All losses of platinum effectiveness are paralleled by a substantial growth in platinum crystallite size.

The Indiana group took a very different approach. They also elected to characterize their catalysts by three criteria:

(1) Platinum crystallite size as determined for X-ray line breadth measurements, the platinum being concentrated by dissolution of the alumina in aqueous hydrofluoric acid.

(2) Fraction of platinum soluble in 25% hydrofluoric acid or in acetylacetone.

(3) Activity for dehydrocyclization, cracking and isomerization of n-heptane.

The Indiana group finds that an appreciable fraction of the platinum is acid-soluble. This is to be read in the light of the statement by the Houdry group that the reason that they use caustic to remove alumina was that sulfuric acid is not satisfactory "because of a loss of small platinum particles." The Indiana group agrees that there is a loss in acid, but attributes this to a portion of the platinum being present in non-metallic form. To substantiate this claim they demonstrate that acetylacetone is as effective as 25% HF in extracting "soluble platinum." Spectroscopic evidence is presented suggesting that, in solution, the soluble platinum is tetravalent; $PtCl_6$ and $Pt(OH)_6$ are suggested for the HF-solutions of chlorided and non-chlorided catalysts, respectively. No direct evidence is given for the form of the platinum as it exists on the surface of the alumina; it is inferred that platinum in the plus four valence state is probably combined with the alumina.

The Indiana group determined the activity of their catalysts by measuring the rates of the various reforming reactions of n-heptane. This is a much more severe test than that employed by Houdry; dehydrogenation of cyclohexane is far less difficult that dehydrocyclization of n-heptane. In this connection it should be pointed out that Houdry reported that catalyst withdrawn from an apparently normally operating reforming unit, and considered to be in good condition, had a very low activity by their cyclohexane test.

The fraction of the platinum in the soluble form is a function of treatment conditions. Reduction with hydrogen tends to convert the soluble form into the insoluble, metallic form. Despite this, as much as one-third of the platinum may remain in the soluble form, even after ten hours under reforming conditions. The presence of chloride ion tends to stabilize the platinum in the soluble form. Although reduction, or reforming operation, tends to insolubilize platinum, oxidation with air restores the platinum to its soluble form.

The importance of these observations lies in the claim by the authors that dehydrocyclization or aromatization activity can be related directly to the concentration of soluble platinum, although cracking and isomerization activity are substantially independent of soluble platinum content. In one example, the rate of dehydrocyclization of n-heptane to toluene was approximately doubled on increasing the soluble platinum fraction from 40% to 100% by appropriate treatment with air. Since the soluble platinum complex is not stable under reforming conditions, frequent regeneration is required in order to maintain activity for dehydrocyclization of paraffins.

The Indiana description of the state of platinum in naphtha reforming catalysts is quite unconventional and is one that is certain to arouse many arguments. Fortunately, the hypothesis is one that suggests many experimental tests; additional data will doubtless lead to new or revised hypotheses. Experimental confirmation might be sought through an attempt at direct detection of $PtCl_6$ on the surface of catalyst by measuring the ultraviolet absorption spectrum of catalyst, using techniques described by Leftin and Hall (Mellon Institute), or Webb (Texaco) for spectral studies on absorbed species.

Pitkethly and Goble (British Petroleum), studied the adsorption of benzene on platinum-alumina catalysts using an ingenious technique based on vapor phase chromatography. Attention was concentrated on that portion of the adsorption associated with the platinum, an irreversible adsorption with all the characteristics of chemisorption. The data and discussion are presented from the point of view epitomized by the Houdry paper first discussed here. It is implicit in the presentation that the platinum is present in the metallic form. It is concluded that the adsorbed aromatic ring is adsorbed flat on a mat of platinum atoms, and that about 0.22 benzene molecule is adsorbed per platinum atom. Various models that could lead to these configurations were examined but no firm conclusions could be reached.

Balandin (USSR) presented a paper in which he brings up to date his now classical geometrical theory of catalysis, combining it with current electronic theories. On the basis of this theory he predicts that technetium will be catalytically active for the dehydrogenation of cyclohexane to benzene. This need cause no concern to our more practical readers; technetium is a man-made element, indeed the first of the elements to be made artificially and is so scarce it is unlikely that sufficient is available for a test of the prediction.

Chromia Reforming Catalysts. One of the more interesting catalytic phenomena of the past 25 years has been the long continuing interest in the mechanism of aromatization of paraffins over chromia catalysts. Despite the fact that platinum and molybdena have been greater commercial successes, chromia has taken the scientific spotlight, particularly in academic circles. In this instance there were two papers on chromia catalysts for aromatization, aside from four other papers on other aspects of chromia. Kim and Krieger (University of Pennsylvania) studied chromia-silica catalysts, noting a maximum in catalytic activity at 4.7 wt-% silica, and suggesting that the catalytically important sites are hydrated chromia sites. Pines and Chen (Northwestern) examined the role of the alumina in chromia-alumina catalysts by studying in great detail the reaction products from the aromatization of cyclooctane and on n-octane-1-C^{14} (n-octane with a terminal carbon atom that is radioactive). The experimental results, obtained by a combination of gas chromatography and radioactive tracer studies, indicated that the dehydrocyclization of n-octane may involve 5-, 6-, 7- or 8- membered ring intermediates. Cyclopentanes are the predominant intermediates over catalyst prepared with an acidic alumina; the larger ring intermediates appear to be formed more readily

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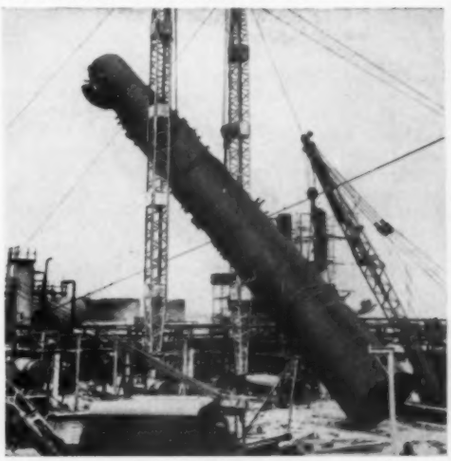

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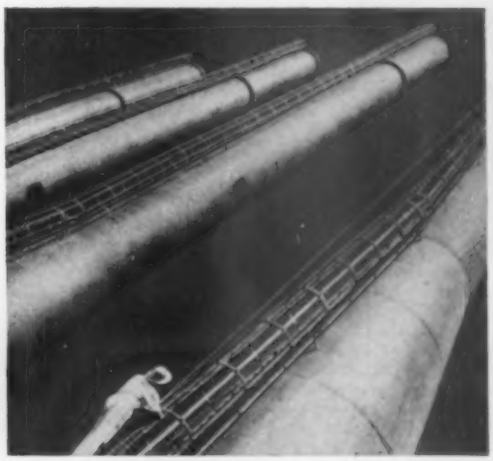

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over chromia on low acidity alumina. The general conclusion is that the mechanism of aromatization is very complex and that the type of alumina used in preparation of the catalyst plays an important role.

Polysite Catalyst Mechanisms. P. B. Weisz (Socony Mobil) discussed reaction mechanisms which involve successive reaction steps with reaction intermediates migrating from one type of catalyst site to another. A number of hydrocarbon reactions proceed over dual catalyst systems in which one component has a hydrogenation-dehydrogenation character, the other component an acidic character. Weisz showed that classical concepts of diffusion can be used to describe and predict the behavior of such catalytic systems. The intermediates have a real existence and can diffuse from site to site through the vapor phase as a normal chemical species. The quantitative aspects were illustrated by examples from the fields of hydroisomerization, hydrocracking and aromatization of alkylcyclopentanes, all of which require bifunctional catalysts.

What's New in Processing Plants

Iranian Oil Refining Co. has awarded a $5 million contract to Fluor-Schuytvlot NV, a subsidiary of the Fluor Corp. Ltd., for design, detailed engineering, purchasing, and construction of a 20,000 b/d Unifiner-Platformer at its Abadan refinery, with completion expected early in 1962.

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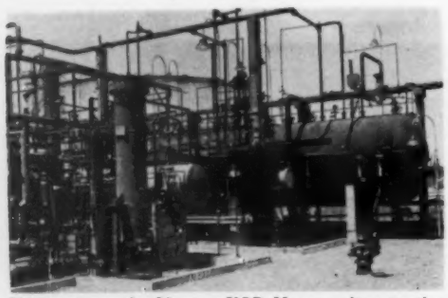

Now onstream is this new UOP Merox unit extracting mercaptans from butanes at Sohio's Cleveland refinery

Standard Oil Co. (Ohio) has put three new UOP Merox units on stream: a 12,000 b/sd unit at Toledo to sweeten light catalytic gasoline; a 1,000 b/sd unit for the same purpose at Cleveland; and another at Cleveland for extracting mercaptans from between 500 and 7,100 b/sd of mixed butanes.

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Kellogg International Corp. has been awarded the engineering and construction contract for the 35,000 b/d refinery Pakistan Refinery Ltd. will build near Karachi. Completion is scheduled for late in 1962. Equipment will include crude distillation, catalytic reforming, and a hydrotreater.

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Four USA companies have been invited to submit contract bids to Vacuum Oil Co. Pty. Ltd. for construction of its £16 million, 30,000-40,000 b/d refinery to be completed in 1962 near Adelaide, Australia. They are Bechtel Corp., Foster Wheeler Co., M. W. Kellogg Co. and Fluor Corp. Ltd.

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Process area of Canadian Oil's new Innisfail refinery

Canadian Oil Co.'s new $4 million, 5,000 b/d refinery near Innisfail, Albera, designed to operate on both natural gas condensate and crude oil, went into operation in mid-October, 11 months after the ground was broken at the plant site.

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The USSR's Angarsk refinery in eastern Siberia, originally scheduled to go onstream in 1961, is now in limited operation, with crude being supplied by tank car via the Trans-Siberian Railroad. The first refinery in the area, the estimated 120,000 b/d plant will eventually receive crude via a 3,200-mile, 25.5-inch pipeline being built from the Second Baku to Irkutsk. It will supply the fuel-short region around Lake Baikal.

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If the Japanese government approves, Nippon Oil Co. will build a 150,000 to 200,000 b/d refinery at Nishinomiya, plus a petrochemical plant and new harbor facilities. Caltex, a partner with Nippon in other refineries, will not be involved in the new proposal.

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Empresa Colombiana de Petroleos, the Colombian government oil company, which will take over full control in March 1961 of the 37,500 b/d Barrancabermeja refinery now operated by International Petroleum (Colombia) Ltd., is considering construction of a new plant or an addition to the existing facilities.

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Murray A. Schutz plans to re-open the Dickinson, N.D., refinery of the former Queen City Oil & Refining Co. in April, 1961, as the Great Plains Refinery. Litwin Engineering Co. has contract for revamp and construction, expanding capacity to 4,500 b/d from present 2,000 b/d.

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Oil-Chem Corp., Dallas, Texas, will build a $4 million, 20 mmcf/d natural gas plant at MacGregor, N.D. with completion in the spring, and designed to increase capacity eventually to 30 mmcf/d.

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Powerine Oil Co. is building the industry's first UOP Lomax unit at Santa Fe Springs, Calif. Using the new hydrogenation process it will convert diesel oil and lower to gasoline. The 2,200 b/d unit will have a yield of 2,537 b/d. The 15% increase of product over charge is due to hydrogen being added. Powerine is also adding a new 3,000 b/d Platformer to existing Platforming capacity of 3,200 b/d in two other units.

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A new 60,000 b/d refinery is being built by Hungary at Szazholmobatta, near Budapest, to be operated on Russian crude oil.

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Spanish Ministry of Industry has rejected application by Petroleos de Galicia to construct a 25,000 b/d refinery at Vigo, Spain.

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San Quirico Refinery Co., Genoa, Italy, has purchased the 10,000 b/d refinery of Aurora Gasoline Co., Elsie, Mich., and plant is now being dismantled for shipment and re-erection in Italy.

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What's New in Petrochemicals

British Petroleum's first installation in the UK to produce special solvents from petroleum spirits has been commissioned at the Kent refinery. Designed by BP, the plant has a capacity of 30,000 ton/yr.

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Monsanto Iberica S.A. of Spain, newly formed as a joint enterprise by Monsanto Overseas S.A. and Aiscondel S.A. of Barcelona, will complete a plant at Monzon in the second half of 1961 to manufacture calcium carbide, acetylene and acetylene derivatives.

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Tidewater Oil Co. and Collier Carbon & Chemical Corp. have boosted the announced initial capacity of their naphthalene plant to be built at Tidewater's Delaware City refinery from 50 million to 100 million lb/yr. A second joint venture naphthalene plant of 50 million lb/yr capacity is under active consideration for the Los Angeles area.

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Lion Oil Co. Division, Monsanto Chemical Co., has placed a 15 ton/day elemental sulfur recovery unit in operation at El Dorado, Ark.

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Shell Chemical Co. will build an 80 million lb/yr polyisoprene plant near Marietta, Ohio, with completion expected late in 1961. Feedstock will come from Shell's Wood River, Ill., refinery. Plans for construction are in progress by C. F. Braun Co. and Ralph M. Parsons Co. Shell's currently operating polyisoprene unit at Torrance, Calif., is now being expanded to 40 million lb/yr.

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El Paso France-Afrique (subsidiary of El Paso Natural Gas Products Co.), and Cie Francaise de Raffinage will build a $17 million polyethylene plant near Le Havre, France. The 44 million lb/yr facility is scheduled for completion in 1963, and marks the first entry of El Paso into European petrochemical markets.

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Esso Petroleum Ltd. will build a $12 million, 30,000 ton/yr butyl rubber plant near its Fawley refinery.

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Royal Dutch/Shell and Montecatini have agreed to form a joint company in the Netherlands—N. V. Rotterdamse Polyolefinen Mij (RPM)—to build and operate a plant which will produce initially polypropylene for plastics. It will be in conjunction with the Rotterdam refinery of Shell Nederland Raffinaderij N. V., and will be based on Montecatini patents. Capital participation will be 60% Royal Dutch/Shell and 40% Montecatini. Production will be on "a large scale" and product sales for the time being will be confined to Benelux countries and handled by Shell group companies.

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Imperial Oil Ltd. plans construction of a $5 million, 30 million gal/yr benzene unit at Sarnia, Ont., with completion in the fall of 1961.

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Monsanto Chemical is starting construction of a phthalic anhydride and phthalate ester plasticizers plant 20 miles southwest of Camden, N. J., the firm's third phthalic anhydride facility.

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Enjay Chemical Co. will increase the capacity of its Baton Rouge, La., benzene unit from the present 15 million to 24 million gal/yr, by the end of 1960.

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International Petroleum (Colombia) Ltd. is building an ammonia and nitric acid plant at its Cartagena refinery in response to South America's growing need for synthetic fertilizers.

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SunOlin Chemical Co. plans a $20 million petrochemical facility adjacent Sun Oil's Marcus Hook, Pa. Designed to produce 225 million lb/yr of ethylene and 55 million lb/yr of ethylene oxide, the plant will be in operation late in 1961. An engineering and construction contract was awarded to The Lummus Co.

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Five USA companies plan a $74.5 million petrochemical complex at the deepwater port of San Lorenzo, Argentina, on the Parana River. Construction will begin as soon as government approval is obtained, with the first units to start operations in about 18 months. The companies are Continental Oil, Cities Service, U. S. Rubber, Witco Chemical, and Fish International Corp. The latter is a Panama subsidiary of Fish Engineering Corp., designer of the installation. Initial annual output planned is: synthetic rubber, 45,000 tons; carbon black, 11,500 tons; surplus styrene, 7,000 tons; plus aviation alkylate, 1,290 b/d and benzene, 839 b/d.

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Heyden Newport Chemical Corp. will complete its 24 million lb/yr maleic anhydride plant at Fords, N. J., early next year.

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Soc. des Elastomeres de Synthese plans a 25,000 ton/yr polybutadiene plant near its nearly finished 50,000 ton/yr synthetic rubber plant at Marseilles, France.

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Dow Chemical Co. of Canada will complete near the end of 1962 a new 12 million lb/yr polypropylene unit at Sarnia, Ont.

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Firestone Tire and Rubber Co. has begun construction of a 10,000 ton/yr synthetic rubber plant at Port Jerome, France, with completion expected in 1961.

• • •

The alkyl benzene plant to be built at Kawasaki, Japan by Oronite Chemical Co. and Japan Petrochemical Co. will cost $4.2 million, have a capacity of 15,000 ton/yr.

• • •

Petroleos Mexicanos has signed an agreement with Soc. Lavorazoni Organiche to build a tetraethyl lead plant at an undisclosed site in Mexico, at a cost of over $10 million.

• • •

Miike Gosei Chemical Industry Ltd., Ohmuta, Japan, plans an 8 million lb/yr maleic anhydride plant, using Scientific Design Co.'s licensed process.

• • •

TRADE MARK

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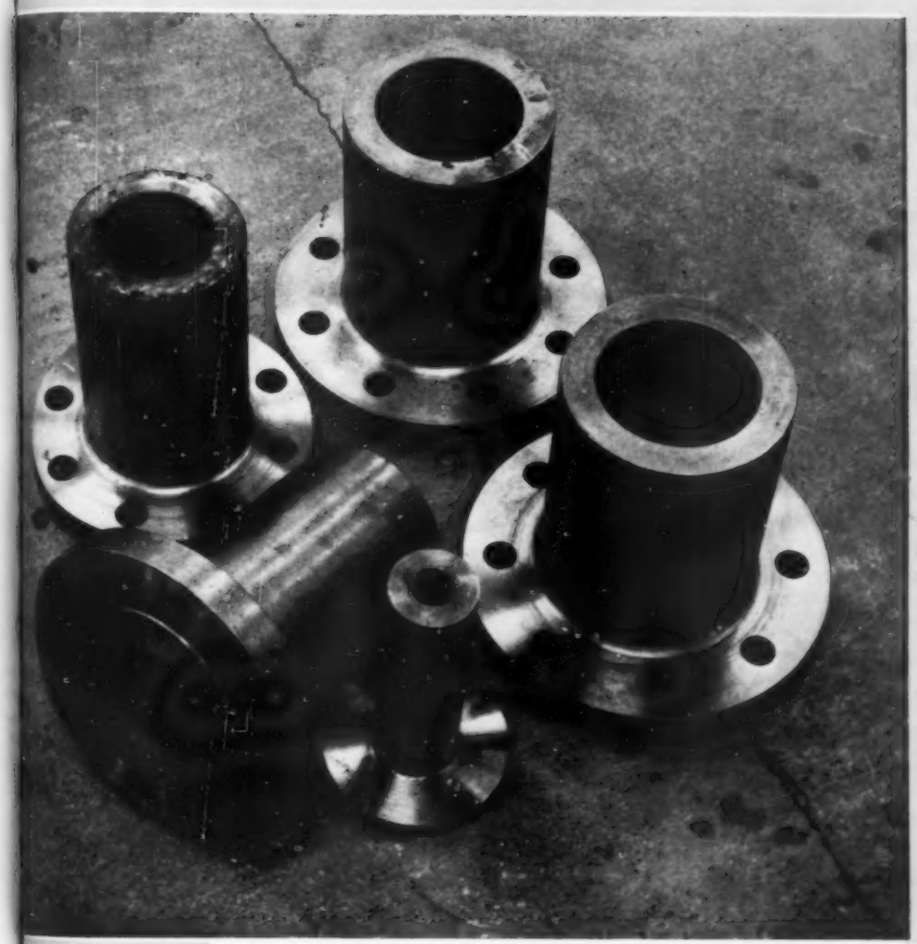
Flanges-



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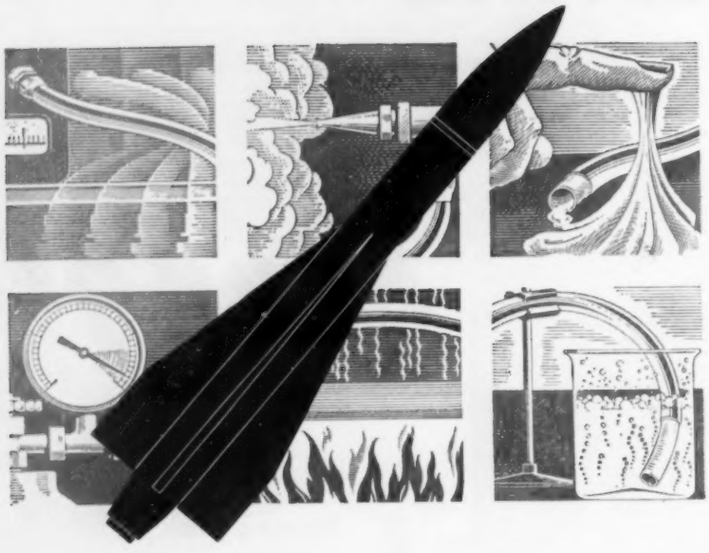

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Automated Hydraulic Rig

(Continued from page 54)

Conclusion and Evaluation. The basic feature of this new British hydraulic rig is the very selective use of automation, kept to a minimum but used to the limit to (1) replace men rather than tie them to control panels, (2) perform operations too fast for manual intervention, and (3) actuate mechanisms on moving platforms where a man cannot go with safety.

It represents an attempt to reintegrate all deep-drilling operations requiring power and to concentrate the vital parts into one transport package. Substantial direct economic advantage can be claimed, chiefly from labor saving and faster tripping, but its full potential cannot yet be defined.

This approach reduces rig size from a "nominal" 47-ft guide-structure, reduces the shift-crew to three men, and yet allows a round trip from 16,000 ft in under 3 hrs.

Details of the mechanisms and the operations of casings, fishing, etc., are available but are not finally fixed since the specification will be altered on completion of a comprehensive survey of the economic performance of conventional equipment now in progress in the various USA drilling areas. With such novel features as the ability to double lifting capacity by linking the two lifts together, the difficulty of specification will be appreciated.

But the general picture is already clear. Competing in hardrock areas against elaborate conventional equipment for very deep drillings, overall cost savings can confidently be expected to exceed 15%. For shallower and softer drilling the savings will be less, and for depths less than 5,000 ft the hydraulic rig will hardly be competitive.

However, if used only where savings are sufficiently large to warrant this major change in equipment, the reduction in overall costs to USA drilling contractors alone could amount to over $60 million a year.

The equipment described, which is the subject of world wide patent applications, was developed by Dowty Rotol Ltd., Cheltenham, England, in association with F. N. R. D. Ltd., 1 Tilney Street, London, W.1, a subsidiary of the National Research Development Corp.—a body set up by the British Parliament to secure the development and exploitation of inventions in the national interest. END

Custom Mobile Rig Truck

Another custom-built rigging has been supplied a Colombian firm by Truck-Trailer Supply Co. Inc. of Stafford, Kans., on a new 1960 GMC Model 9029 Truck (276 in wheel base). Shown in the photo above, the truck is equipped with the following: Samson Oil field Bed, 70L Tulsa winch, 34L Tulsa winch (both are air-operated), Texas style 4½-in gin poles, and all necessary auxiliaries. Truck-Trailer Supply Co. distributes its products world-wide.

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OR **TRETOLITE**

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Salt removal is now a routine operation in all modern refineries. With the need for effective desalting widely recognized, the main problem today is the selection of that equipment which will do the most efficient job at the least possible cost.

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■ ***The first electric desalter was designed and installed by Petreco engineers.***

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Tretolite chemical formulations were the first ever to be used in desalting. Tretolite desalting units are the only exclusively chemical desalters ever to be sold and installed in the refining industry and are currently used to desalt a million and a half barrels per day. In fact, every important development in crude oil desalting has resulted from the Petrolite research, engineering and development program.

Because Petreco offers both kinds of desalters, the company has no "axe to grind". This means that you get an honest and objective appraisal of the method best suited to your operation.

There is no other desalting equipment on the market today that can offer you comparable efficiency of design. The operating records from installations around the world *prove* it! There's no other company, either, that can offer you Petreco's fund of desalting technology or Petreco's rich background in this highly specialized field.

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NETHERLANDS: F. E. C. Jenkins, Hoefbladlaan 134, The Hague
PERU: Oilfield Import, S. A., Apartado 71, Talara
TRINIDAD: Neal and Massy, Ltd., P.O. Box 544, Port of Spain

Recent USA Patents on Hydrazine and Substituted Hydrazines

(*Continued from page 92*)

the Olin Mathieson Chemical Corp.) concentrated hydrazine may be stabilized against decomposition or corrosive action by the addition of a small amount of metal oxide selected from aluminum oxide, zinc oxide, or cadmium oxide.

SUBSTITUTED HYDRAZINES

The substituted hydrazine which is most used in high energy fuels is unsymmetrical dimethylhydrazine. B. H. Nicolaisen and C. J. Smith of the Olin Mathieson Chemical Corp. (2,858,254) have found that UDMH formed in dilute solution from the Raschig process can be concentrated by fractional distillation at pressures above 15 psig. In 2,876,173, Nicolaisen states that UDMH does not form a constant boiling mixture with water, however, distillation from water is difficult due to the shape of the vapor pressure curve. Sodium chloride is known to make the fractionation somewhat easier. This inventor has found that sodium hydroxide is much better than salt for this purpose, and proposes to add 1-30 wt-% of the hydroxide to the UDMH solutions. D. Horvitz (2,802,031 to Metalectro Corp.) proposes an improvement to the process for making UDMH by reduction of N-nitrosodimethylamine. The improvement resides in carrying out the reduction with zinc or aluminum and an inorganic alkali. The several advantages claimed for this procedure are: (1) elimination of the need for costly acetic acid, (2) elimination of the need for large excesses of either acid or alkali, (3) permits distillation of the product without prior neutralization and (4) reduction of total volume of liquid.

W. T. Barrett and P. L. Veltman of W. R. Grace & Co. in 2,808,439 prepare substituted hydrazines by first reacting chlorine in the vapor phase with at least two moles of a lower alkyl amine contaning at least one hydrogen on the nitrogen. Care should be taken to prevent formation of a liquid phase, the temperature being maintained above 50 C. The hydrazine is now made by reacting ammonia with these chloramines in such a manner that the concentration of the chloramines is less than one mole per liter. F. R. Hurley (2,901,511 to W. R. Grace & Co.) proposes to improve the reaction between chloramine and a substituted amine by the addition of a tertiary amine to the reactants.

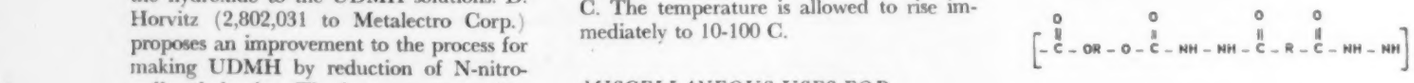
G. F. Grillot and R. C. Chang of W. R. Grace & Co. in 2,855,435 make diethylbiurea, a substituted hydrazine, by reacting dichlorourea with ethylamine at temperatures around 0 C. In 2,917,545 (D. W. Lum and I. L. Mador to National Distillers and Chemical Co.) alkyl hydrazines are produced from alkyl ureas by treatment with sodium hypochlorite and sodium hydroxide at —5 to 20 C. The temperature is allowed to rise immediately to 10-100 C.

MISCELLANEOUS USES FOR HYDRAZINE

P. R. Kippur (2,806,880 to Olin Mathieson Chemical Corp.) prepares this semicarbazide by adding slowly a 45-85% solution of a hydrazinium salt to a 45-80% aqueous thiocyanate solution. The temperature should be maintained at 115-140 C. The addition should be continued until the thiocyanate-hydrazine ratio is from 1:1 to 2:1.

Hydrazine decomposition to hydrogen and nitrogen is sometimes used as a gas generating reaction for propulsion purposes. O .J. Plescia and R. M. Mantell of the M. W. Kellogg Co. in 2,926,144 propose catalytic compositions to aid the reaction. The compositions comprise essentially cobalt, copper, and an alkali metal in weight percentages of 30-80, 10-45, and 10-45 respectively. For example, a mixture of cobaltic oxide, cupric nitrate, and sodium bicarbonate initiates the decomposition of hydrazine at room temperature. R. T. Wendland (2,930,750 to Gulf Research & Development Co.) removes elementary sulfur from hydrocarbon liquids by contacting them with hydrazine and taking advantage of the following reaction: $2\,S + N_2H_4 \rightarrow 2\,H_2S + N_2$. Ordinary liquid contacting methods may be used for this process.

In 2,941,984, H. D. DeWitt of the Chemstrand Corp. patents a filament forming, hydrazine derived polymer containing recurring units of the following structure:



A. A. Pessalano and R. L. Clark of Merck and Co. in 2,944,071 received the patent on the hyrazine derived composition of matter of the general formula N-(3,3-diphenyl-3-hydroxypropionyl), N-acyl hydrazines.

Automatic Custody Transfer

(*Continued from page 86*)

equipment will mean a resultant decrease in maintenance and replacement costs, especially important where corrosion is a problem.

With fewer tanks and a more continuous flow of oil, the heating requirements are considerably lessened, thus minimizing capital investment, operating and maintenance costs associated with tank heating equipment.

Because switching, gauging, and thieving functions are eliminated, manpower can be assigned to more productive work. This could also result in cutting down mileage and travel time, which might be appreciable in large areas with extensive ACT coverage. Oil inventories are reduced significantly, and the inaccessibility of battery sites due to inclement weather becomes less critical.

The chief benefits to the pipe line operator are derived from economics in gathering costs. Where custody transfer takes place automatically, the gauger need visit a given battery only once or twice a month, as compared with daily visits to batteries not on ACT. Although a maintenance and meter proving staff must be created, net savings are still considerable, as a result of more efficient use of manpower. Accounting procedures can be simplified due to the lower number of run tickets which must be processed. As in the case of the producer, savings in mileage and transportation costs can also be an important factor.

A formalized agreement between producer and pipe line operator is a must if the maximum benefits are to be obtained from ACT. Before a first venture into this phase of oil field automation, the two parties involved must reach a complete meeting of the minds on the division of responsibilities for installation, costs, operation, and maintenance. Furthermore, both parties must be prepared to accept, without challenge, industry experience to date in the design and operation of ACT systems. In view of this large backlog of experience it is entirely unrealistic to regard each new installation as an experiment that must be given a lengthy test before it can be accepted. Testing has already been done, and on a far larger scale than any individual operator could afford to undertake.

If this is understood, haggling over minor details can be avoided, engineering time kept to a minimum, and a formal working agreement reached expeditiously.

The Future?

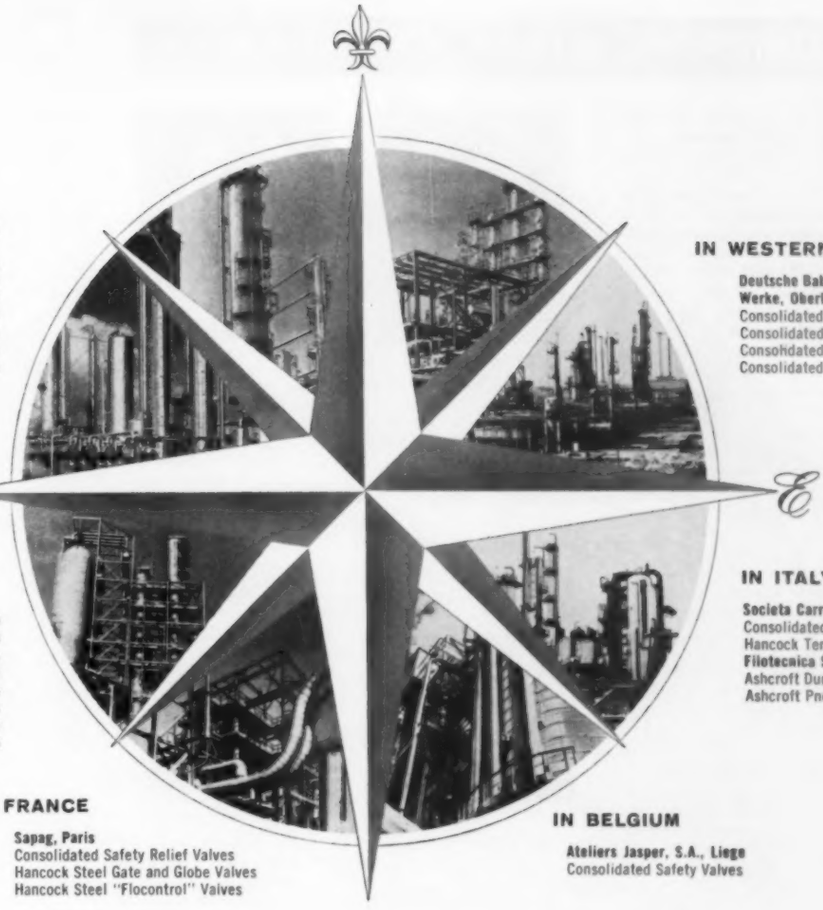
A natural corollary to the needed growth in co-operation between producer, pipe line operator, and regulatory bodies will likely be technological advances which will permit even more extensive exploitation of the advantages of ACT in the future.

One trend which is fairly certain to be established is the conversion of larger installations to a continuous transfer basis. In these installations, the speed or discharge rate of the transfer pump will be regulated directly by the incoming production rate. This will lead subsequently to the complete elimination of tankage for the transfer process. To compensate for shrinkage, pipe line operators may then have to embark on comprehensive vapor recovery programs.

Another likely trend will be the use of meters which can record transfer data on punched cards or tape, so that automatic data processing equipment can be used to reduce accounting and billing costs.

The development of an extremely accurate and reliable means of measuring BS and W content could lead to the direct transfer of all produced fluids to the pipeline, with dehydration being accomplished at the pipe line terminal, or at the refinery. Such a system would make it feasible to undertake large scale unitization and automation of surface producing facilities.

These are but a few of the possibilities which stem from the relatively simple beginnings of ACT. The problem for the immediate future is to expand its application whenever and wherever the opportunity arises. END



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Consolidated "Maxiflow" Safety Valves
Consolidated "Electromatic" Relief Valves

IN WESTERN GERMANY

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Consolidated Safety Relief Valves
Consolidated Safety Valves
Consolidated "Maxiflow" Safety Valves
Consolidated "Electromatic" Relief Valves

IN CANADA

Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario
Ashcroft Gauges
Consolidated Safety and Safety Relief Valves
Hancock Bronze and Steel Valves
American Bi-Metal Thermometers
American Temperature Regulators

IN ITALY

Societa Carraro & Co., Milan
Consolidated Safety Valves
Hancock Temperature Regulators
Filotecnica Salmoiraghi—SPA, Milan
Ashcroft Duragauges
Ashcroft Pneumatic Transmitters

IN FRANCE

Sapag, Paris
Consolidated Safety Relief Valves
Hancock Steel Gate and Globe Valves
Hancock Steel "Flocontrol" Valves

IN BELGIUM

Ateliers Jasper, S.A., Liege
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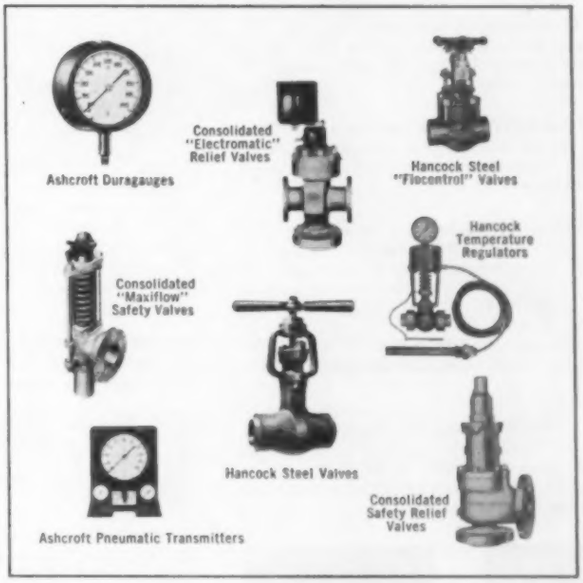

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OIL COMPANY STAFF CHANGES

J. S. ROYDS, administrative vice president and general manager, domestic exploration department, has been appointed to the new position of vice president and exploration manager for Continental Oil Co.'s foreign exploration and production department, New York. **W. O. HAM, Jr.,** general manager of Conoco's southwestern region, has been appointed general manager of the domestic exploration department in Houston, succeeding Mr. Royds. **HAROLD R. PRESCOTT,** former assistant general manager, foreign exploration and production department, has been promoted to the newly created position of assistant manager, domestic exploration department.

RICHARD C. SAUER has become executive vice president Standard Oil Co. (Ohio) and **ELLIOTT B. McCONNELL** has relinquished his responsibility for the company's manufacturing operations in order to devote his time as a senior vice president to the guidance of the research department and to the direction of efforts to develop and utilize scientific management techniques.

RAYMOND M. LARSEN, petroleum engineer with the U. S. Geological Survey at Casper, Wyo., has been honored by the Society of Petroleum Engineers of AIME for his outstanding contributions to Society activities.

Mr. Larsen, one of five SPE members to receive 1960 certificates from the Society, was chosen for his work with the annual volume on statistics of oil and gas development and production.

RALPH J. SCHILTHUIS, executive vice president and member of the board of management of the Humble Div. of Humble Oil & Refining Co., has received the 1960 John Franklin Carll Award presented by the Society of Petroleum Engineers of AIME.

The award carried the following citation: "In recognition of his important contribution to the technology of petroleum engineering and for his example in applying engineering principles to the problems of industrial management."

Mr. Schilthuis has previously been honored for his engineering achievements when he received the Alfred Noble Prize in 1938 from the founder engineering societies for an outstanding technical paper written by a member no more than 30 years old.

WARREN O. CARLSON has joined the consulting firm of Beaco, Ltd., Montreal, as vice president in charge of the refining division. He will establish his offices in Calgary, Alberta.

PAUL W. SHELDON has been appointed advertising coordinator for all domestic and international advertising, media research, and advertising planning for the Gulf Oil Corp.

JOHN H. STRANGE has been named administrative assistant to Dr. Philip C. White, general manager of research and development, in the Chicago office of Standard Oil Co. (Indiana). At the Whiting, Indiana laboratories, **MORRIS T. CARPENTER** and **THOMAS G. STACK** are appointed assistant directors of administration, and **DONALD G. SCHROETER** replaces Mr. Stack as superintendent of employee relations.

HERBERT F. BEARDMORE has been elected a vice president, Gulf Oil Corp., in charge of U. S. production. He will succeed **ROBERT L. BOGGS,** who has retired after 33 years of service, 22 of which were spent in foreign operations.

H. F. Beardmore

F. V. Williams

K. F. Madsen

H. P. Caldwell

HAMILTON P. CALDWELL has been elected vice president for manufacturing Mobil Oil Co. de Venezuela; **J. HOWARD CASEY** was elected for producing; **KARL F. MADSEN,** for marketing; and **JOSEPH H. POE,** for finance and industrial relations. **JOHN C. THOMPSON,** the company's comptroller and treasurer, has been elected to the board of directors. The four vice presidents are also members of the board.

J. H. Casey

J. H. Poe

REXFORD S. BLAZER, Ashland Oil & Refining Co., Ashland, Ky., was reelected to a second term as president of the National Petroleum Association.

Also reelected were: **JOHN E. SELDEN,** South Penn Oil Co., Oil City, Pa., first vice president; **L. E. KINCANNON,** Rock Island Refining Corp., Indianapolis, Ind., second vice president; **GUY B. HUNTER,** Quaker State Oil Refining Corp., Emlenton, Pa., treasurer, and **O. P. KEENEY,** Oil City, Pa., recording secretary.

FAYETTE B. DOW, Washington, D. C., was named honorary counsel and **DONALD C. O'HARA,** Chevy Chase, Md., former assistant general counsel to succeed Mr. Dow.

GEORGE H. UNZELMAN to chief refinery technologist for the western region of Ethyl Corp., with headquarters in Los Angeles.

LUKE S. GOURNAY, senior research physicist for Socony Mobil's field research laboratory in Dallas, Tex., has been awarded the 1960 Socony Mobil Incentive Fellowship. He has enrolled in the University of Colorado's Graduate School where he will seek a Ph. D. degree in physics. The Incentive Fellowship award allows Mr. Gournay up to three years to obtain the degree.

JOHN R. INGRAM has been appointed manager of Standard-Vacuum Oil Co.'s lubricating and special products supply department.

A. F. HAMILTON has been elected vice president and general manager of Texas Gas Exploration Foreign C. A. The company is the wholly owned foreign operations subsidiary of Texas Gas Exploration Corp., Houston.

LAWRENCE A. KIMPTON has joined Standard Oil Co. (Indiana) as general manager of planning, a new position. The chancellor of the University of Chicago has been a director of Standard Oil for two years.

FRANK V. WILLIAMS has been appointed refinery manager of Durban, South Africa, for Standard-Vacuum Refining Co. of South Africa Pty Ltd. Mr. Williams has been a member of Stanvac's international headquarters staff for the last five years and manager of its Lubricating and Special Products Supply Department at White Plains since 1958. Before joining Standard-Vacuum, he was refinery manager of Mobil Oil Co.'s Olean, N. Y. plant.

CHARLES H. DODSON has been elected a vice president in charge of Texaco Inc., midwest operations with headquarters in Chicago, effective September 15.

HARRISON B. HANEY, vice president of transportation, Tidewater Oil Co., has retired after 43 years of Tidewater service.

P. H. SWINCHATT, assistant to the president of Shell Oil Co. and vice president of Shell Pipe Line Corp., will retire December 31, 1960, after nearly 40 years' service with Shell. He will be succeeded by **E. A. HUGILL, Jr.,** who is currently secretary of Shell. Mr. Hugill will combine his new administrative duties with his present corporation secretarial responsibilities.

LLOYD E. ELKINS, of Tulsa, production research director for the Pan American Petroleum Corp., will become President-elect in February of the American Institute of Mining, Metallurgical and Petroleum Engineers.

Also named to take office in February are several vice presidents, for one year each, and directors, for three years each.

Among the vice presidents are: **JOHN S. BELL,** of Houston, Gulf coast area production manager, Humble Oil & Refining Co., and former president of the Society of Petroleum Engineers of AIME.

WAYNE E. GLENN, of Houston, general manager, production, Continental Oil Co., now president of the Society of Petroleum Engineers of AIME.

Among new directors will be **ROBERT B. GILMORE,** of Dallas, vice president of DeGolyer & McNaughton (representing Society of Petroleum Engineers).

GEORGE L. SCOTT, coordinator, organization planning, for the Gulf Oil Corp., has been appointed manager, employee relations and organization planning for Gulf European Co., a Gulf subsidiary company headquartered in London, England.

EDWARD C. MITCHELL has been appointed assistant to vice president, foreign operations department (Eastern Hemisphere) of Texaco Inc.

MARION J. EPLEY, Jr., formerly vice president and assistant to the chairman of Texaco Inc. has been named senior vice president in charge of world-wide sales. **KERRYN KING,** formerly vice president in charge of the employe and public relations department, has been named vice president and assistant to to chairman. **BEN HALSELL,** formerly director of advertising and sales promotion, has been elected vice president in charge of employe and public relations.

W. J. WOOTEN has been elected vice president and manager of exploration for Texas Gas Exploration Corp.

JOSEPH T. FROEHLICH, formerly general manager of the foreign operations department (Eastern Hemisphere) in the New York offices, has been appointed general manager of Texaco Trinidad, Inc., at Pointe-a-Pierre, Trinidad. **JAMES A. HULME,** formerly general manager of Texaco Trinidad, was named general manager of the foreign operations department (Eastern Hemisphere) of the parent company in New York.

LEWELL ADAIR to manager and vice president of Libyan Atlantic Co., responsible for all operations—exploration, drilling, production, and governmental relations connected with Libyan Atlantic's recent acquisition of 6½ million acre concession offshore Libya. His headquarters will be in Tripoli.

W. C. TEAGLE JR.

Walter Clark Teagle, Jr., 47, son of the former president of the Standard Oil Co. (N.J.) died October 5. He was a director of American Petrofina and an officer in the Teagle Foundation and a number of companies.

D. E. BUCHANAN

Darst Eugene Buchanan, 68, pioneer refiner and natural gasoline manufacturer in the Mid-Continent, died at his home in Denver, Colo., on Sept. 14. He was active in the formation of the Natural Gasoline Association of America which he served as president for two years.

NATURE'S CATALYSTS (2)

The First Catalytic Reaction

The first reproducible catalytic reaction to be carried out was the process of wine making. Vinous fermentation is a natural phenomenon brought about by the catalytic action of the enzyme zymase, which is present in the yeasts found on the skins of all grapes. Viticulture and wine making were practised in the Ægean in the early Bronze Age, and the same basic methods are still in use throughout the world today.

In contrast, methods used in the modern chemical industry are changing rapidly under the influence of continuous developments in catalysis. And the research laboratories of I.C.I. are playing a prominent part in both fundamental work on the properties of materials in the solid state and the practical development of new and improved catalysts.

Full information on I.C.I. CATALYSTS *is available on request:*

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INTERNATIONAL NEWS AND NOTES

AFRICA—Six new companies have been formed to carry on British Petroleum and Shell oil marketing in various areas. These are BP Ocean Islands (nominal capital £15,000); BP Uganda (£75,000); Ocean Islands Shell (£150,000); Tanganyika Shell (£600,000); and Uganda Shell (£200,).

ALASKA—Houston oilman Halbouty has started his second test on Alaska's Kenai peninsula. Projected to 9,000 ft, the new No. 1 Bishop Creek well is on a 30,000-acre tract 15 miles west of the Swanson River field and 12 miles north of the new Kenai gas field...

ALBANIA—The Czechoslovakian monthly *Zahranicni Obchod* reports Albania's increase in oil reserves has put the country into third place in Europe—after the Soviet Union and Romania. Reserves are now estimated at 100 million tons. During 1959, Albania produced 479,400 tons of crude, 18.9% more than in 1958. During the past four years crude output has risen 130%.

ANGOLA—Crude production in Angola in the first half of 1960 totaled 31,892 tons (abut 1,300 b/d), against 23,111 tons in the comparable 1959 period. Refinery output rose to 78,265 tons in the first half of this year, against 20,587 in the same 1959 six months. Venezuelan crude was imported for refinery throughput. Petrofina has 18 wells producing a total 1,300 b/d. Currently combined production of three of the four wells in the Galinda field in the game preserve southeast of Luanda averages 580 b/d. A fifth well is being drilled. The Bom Jesus field is not so promising as the nearby Galinda field. For reasons of economy, Petrofina has been cutting back local and foreign employees, but it is going ahead with plans to expand the Petrangol plant to 500,000 metric tons per year (10,000 b/d).

AUSTRALIA—Delhi Australian et al. have now scheduled for mid-October their third Australian wildcat which was to have been spudded last August on Mornington Island in the Gulf of Carpentaria. Delay resulted from the grounding on a reef of the Ship carrying the drilling rig. Delhi's first two tests proved dry.

AUSTRALIA—Ampol Petroleum, a major Australian marketing firm, has an option on a Queensland refinery site, where it operates bulk-storage facilities. The company is the parent of Ampol Exploration, which has an interest in the WAPET exploration program in Western Australia.

BURMA—Crude-oil output in Burma during April was 10,137,000 imperial gallons, and the March figure is reported at 13,432,000 gal. Gasoline production during April was 3,738,000 gal; kerosine 2,518,000 gal, and other fuel oils 2,041,000 gal.

EASTERN HEMISPHERE—Superior Oil Co. has incorporated in the USA two subsidiaries preparing for entry into oil operations in the Eastern Hemisphere. If the Libyan government approves and qualifies the company, Superior expects to begin either as operator on existing rights or on new rights to be acquired—although which of the two the company has not disclosed. In Pakistan, Superior will be minority partner in an exploration venture as soon as the Pakistani government qualifies the company. Despite Superior's difficulties in disposing of its oil in Venezuela (only country outside the USA and Canada where the company has operated to date), Superior will be moving into other countries in the future—"any place where we feel we can find oil," according to Superior's president Keck.

FRENCH SAHARA—Reports from Tunis state Edjele oil would flow through the Trapsa pipeline by September, according to estimate by Paul Moch, director general of Creps (Cie. de Recherches et d'Exploitation de Petrole au Sahara). Two large storage tanks at LaSkhirra have been completed ahead of schedule, he says.

FRENCH SAHARA—Franco Delhi (wholly owned subsidiary of Canadian Delhi Oil Ltd.) and associates have been awarded a second large oil and gas exploration concession in Algeria by the French government. The 1,047,820-acre permit is in the Hamra area, about 120 miles south of Hassi Messaoud and about 170 miles northwest of Ejele-Zarzaitine-Tiguentourine fields. Nearest production is a natural-gas and distillate discovery well four miles distant. The group received a permit of 445,000 acres in the Daiet El Habe area of Algeria in 1958, where it is considering its first test.

Franco Delhi is operating partner for a syndicate which includes El Paso Natural Gas, Home Oil Co. Ltd., the French companies PETROPAR and FRANCAREP, E. Constantin Jr., Allen & Co., and Vaughn Bros.

FRENCH SAHARA—Affiliates of Cities Service and British Petroleum are seeking five new concessions in the French Sahara. Cities Service (with the French firm PREPA) has filed for 816 square miles, and Soc. Saharienne de Recherches Petroles (new BP affiliate) for 1,614 square miles.

FRENCH SAHARA—First official tanker loading of Edjele crude at the Tunisian port of La Skhirra was scheduled for October 1. Initial capacity of the 460-mile 24-in. system moving crude from Edjele, Tiguentourine, and Zarzaitine fields in the eastern French Sahara near the Libyan border is 144,000 b/d—to be raised to 190,000 b/d next year with expansion of pumping facilities.

FRENCH SAHARA—To widen the European markets for its African oil, France for the first time has granted permits in the French Sahara to West German and Italian firms. Out of 15 companies in nine groups recently awarded permits, two were to West Germans. Gewerkschaft Elwerath (West German firm in which Esso and Shell have minority interests) obtained jointly with the French firms EURAPREP and PETROPAR the 1,197-square-mile Hassi Nechou permit for an initial five-year term, with minimum investment of $1.6 million. Wintershall AG (independent German producer-refiner), also jointly with EURAFREP and PETROPAR, obtained an initial five-year 772-square-mile permit in HassiMestour—with minimum investment of $1 million. The three Italian groups represent affiliates of Montecatini, Fiat, and Snia Viscosa, all private industrial interests. With PREPA as their French partner, the three are combined in a single venture on the 1,506-square-mile Hassi Allal-Erg Sedra permit. Up to now, only one other private Italian firm has held an exploration interest in Algeria.

GHANA—Two new trade agreements signed in Moscow call for importation into Ghana of Russian oil products, and for Russian economic and technical aid to Ghana (including geological prospecting). A long-term Soviet credit of 160 million rubles (about $40 million at official rate) has been extended Ghana.

GREECE—The Greek government has the right to supply 30% of the crude capacity at the Hellenic Petroleum Refining Co. plant, which last year processed some 250,000 metric tons (5,000 b/d) of crude bought by the Greek government from the Soviet Union in May 1959. During 1960, the refinery has been processing some 450,000 tons bought from the USSR late in 1959. Mobil Oil Co., which has an interest in the refinery, reports processing of non-Soviet crude in the first half of 1960 came to 609,197 tons (somewhat under 25,000 b/d), against 732,827 tons in the first half of 1959. Imports of non-Soviet crude were 632,820 tons in the first half of 1960, against 718,106 tons in the same period of 1959.

INDIA—Both in the private and public sectors, India is facing difficulties with its refining program. Burmah-Shell, which wishes to expand capacity of its Bombay facilities to 78,000 b/d from 52,000 b/d, has met with resistance on the ground the government believes a new plant at Madras or Cochin would be economically preferable, whereas the company insists a new plant in southern India would cost double additional capacity at Bombay. Furthermore, proposed revisions to the refining agreement under which the existing Burmah-Shell plant was built may spread to the two other private refiners, Standard Vacuum and Caltex. Because of failure to include the cost of offsite facilities, plus other difficulties, the 15,000 b/d refinery at Gauhati in northeastern India may end up costing the government double the $21 million originally estimated.

INDIA—The Indian government has notified Western oil companies it is not satisfied with the 11% to 12½% reduction in crude prices offered by the three refiners operating within the country. Because of the world-wide oil glut, India believes prices should be reduced further. Oil minister Malaviya also ruled out the possibility of the Indian government's accepting 50-50 profits-split with foreign oil companies.

INDIA—Though it has decided to withdraw from its joint 25% government—75% Stanvac partnership oil hunt on a 10,000-square-mile concession in Bengal (eastern India), Standard Vacuum may search in the western part of the country where it already has applied for a 10,000-square-mile permit in the Rajasthan region. This time it wishes to go it alone —100%.

IRAN—ENI (Italian State Oil agency) is reported retesting its first offshore wildcat at 11,011 ft. Despite earlier claims of 3,000 b/d to 5,000 b/d potential, the well may prove noncommercial.

IRAQ—The Baghdad press reports the Iraqi government received $68 million as its share of oil revenues for the period March to June 1960, an increase of three million dinars over the corresponding 1959 period. Iraq expects to earn $3 billion for all of 1960. Though oil exports from the southern fields had dropped slightly because of the reported dispute over increased cargo dues between Basrah Petroleum Co. and the Iraqi government, exports from the northern fields had reached about 35 million tons.

ISRAEL—A Tel Aviv dispatch reports Lapidoth Israel Oil Prospectors Ltd. has discovered a second oil field in the Negev desert, five miles north of the Heletz field. No 3 Negba found 7 ft of oil-saturated sands at 5,450 ft, 100 ft below a 2-ft layer found earlier. Expected production is 120 b/d of 30-gravity crude, similar to Heletz oil.

IVORY COAST (West Africa)—In pursuance of an agreement signed in Paris in mid-July, the Ivory Coast (formerly a member of the French Overseas Community) has declared itself an independent nation.

JAPAN—The Japanese-owned Arabian Oil Co. wants government assistance in moving 500,000 to 600,000 tons of Neutral Zone crude to Japan during the first quarter of 1961—for 80% allocation to all Japanese refiners.

LIBYA—Rated production in Libya has risen to 84,004 b/d of crude and 16.5 mmcf of gas daily. Pro-

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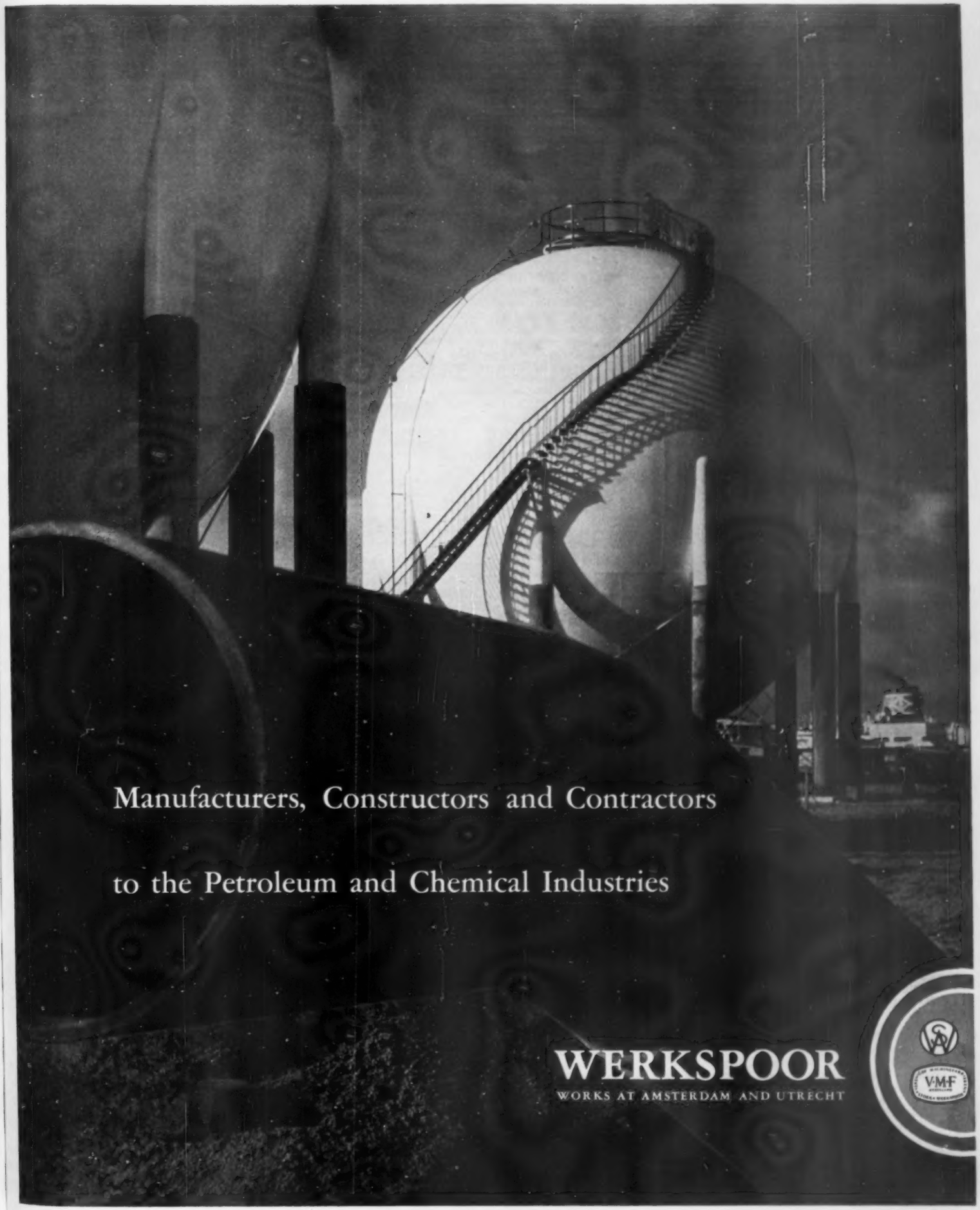
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ducing oil wells total 38—with three gas wells. Drilling rigs in operation number 34.

LIBYA—A unique technique has been devised to speed delivery of the pipes to be used for Libya's first pipeline, on which work has been begun by Esso Standard (Libya). The 30-in. diameter pipes of the line, which will bring oil from the new Zelten field to market late in 1961, are cut in 40-ft lengths and securely sealed with plastic plugs. Thus made watertight, they are floated ashore at Marsa el Brega on the Gulf of Sirte, the ocean terminus of the pipeline, only 100 miles from the producing field. While this method presented problems, which were solved as they developed, it has made it possible to get the pipe in before a dock could be constructed.

MIDDLE EAST—Esso Export Corp., effective September 14, 1960, upped Middle East crude prices slightly to bring them in line with prices posted by the majority of other Middle East oil suppliers. The increases range from 2¢ to 4¢ per bbl.

MIDDLE EAST—Shell International Petroleum Co. Ltd., a member of the Royal Dutch-Shell group, has restored part of the price cuts it made in the Middle East crude oil in mid-August. The company announced it was increasing Mideast crude prices 2¢ to 4¢ per bbl. In August it had reduced these prices 6¢ to 14¢ per bbl.

NEW ZEALAND—Among provisions in New Zealand's new budget are (1) an exemption from a company's excess profits tax on behalf of new buildings, plant, and equipment, plus a special depreciation allowance for plant and machinery; (2) a cut of two cents bringing the price of gasoline down to 40¢ per gal; (3) a reduction to 33 1/3% from 40% in the sales tax on motor vehicles.

PAKISTAN—Pakistan will accept help from the USSR in its oil exploration program. On arrival of Russians in Pakistan, a preliminary study will be made.

PAKISTAN—Because Pakistan believes it has been paying from 15% to 20% above oil prices posted in the international market and could in the past have saved considerable foreign exchange had it had proper technical advice, the Pakistan government is reported negotiating with the National Iranian Oil Co. for the services of an Iranian to advise Pakistan with respect to oil purchases from international oil companies.

Pakistan has been reviewing oil-product prices within the country, and its minister of fuel, power, and natural resources has announced negotiations are in progress for their reduction. Pakistan has asked India for details on the reduction in Middle East crude prices made by Western companies to India.

PERSIAN GULF—An initial price of $1.67 per bbl has been posted for 31-31.9 gravity Gach Saran crude f.o.b. Kharg Island, the new Iranian terminal on the Persian Gulf—with a differential of 2 cents for each degree of change in gravity. This is to match the price posted for Kuwait crude of similar grade at Mina al Ahmadi.

POLAND — A government official has indicated Poland may seek some Western process licenses for the 120,000 b/d refinery to be built with Russian assistance at Plock.

SAUDI ARABIA—Crude delivered from Sidon, Lebanon, by Trans-Arabian Pipe Line Co. for month of August 1960 dropped to 255,946 b/d against 303,093 b/d for August 1959. Total deliveries for first eight months of 1960 were 57,099,801 bbl, a drop to 234,016 b/d. Total deliveries for first eight months of 1959 were 84,709,884 bbl, for an average of 348,600 b/d.

SAUDIA ARABIA—Beirut sources report Tapline is reducing its marine pipeline facilities at Sidon, Lebanon, partly because deliveries of Saudi Arabian crude to the Mediterranean have dropped to the lowest level in 10 years. Tapline also is disposing as surplus of three of its eight mooring launches and one of its five loading berths—two of the surplus mooring launches being purchased by Esso of Libya for the latter's offshore terminal now building at Marsa el-Brega for crude export from Esso's Zelten field in Libya. Despite these reductions, the Sidon terminal will still be able to handle comfortably as much crude as can be pumped through the giant Tapline stored in the tank farm at capacity level.

SPAIN—Monsanto Chemical Co. has announced formation of Monsanto Ibercia SA, in Spain. It is a joint subsidiary with Aiscondel SA of Barcelona. The new firm was set up under a recently enacted Spanish law allowing foreign companies to hold 50%, instead of 25% equity in Spanish companies.

TURKEY—Mobil Oil Turkey AS (Mobil International affiliate) is investing $15 million for new service stations, storage depots, and transport facilities in Turkey.

TURKEY—Following two recent widely separated oil finds—one at Kuleli and the other at Bulgardag—NV Turkse Shell, Turkish operator for Royal Dutch Shell group, reports a strike in Southeastern Turkey, 30 miles northeast of Diyarbakir. Initially the wildcat flowed 22 bbl of 38-gravity crude on a 108- min test from 6,233 ft.

UNITED KINGDOM—London shipping sources report two transactions have been concluded for shipment of Russian oil in British tankers. Companies said to be involved are Cambridge (Tankers) and London & Overseas Freighters. These would be the first large western shipping agreements with the Soviet Union since announcement in July by SONJ that it would "take into consideration" when chartering tankers whether owners had contracted to carry Russian oil. With no details of Cambridge transaction, London & Overseas is said to have contracted to transport one million tons of Black Sea oil in a two-year period, at almost double current rates. Although this estimate is discounted by most brokers, they agree the Russians are paying an attractive price.

UNITED KINGDOM—London reports that Cie. Francaise des Petroles, France's largest oil company, expects to market in the United Kingdom. Spokesman for company says it probably will supply gasoline from its French refineries to Total Oil Products, an affiliate already established in the U.K.

USSR—According to the recently published "Handbook of Soviet Foreign Trade," the USSR last year exported 12,485,300 tons of crude oil (1958: 9,092,600 tons) and 12,886,700 tons of products (9,045,400). Purchasers of Soviet crude outside the Soviet bloc were headed by Italy (2,360,300 tons /1,026,500/), followed by the United Arab Republic (970,800 tons /1,330,400/), and Finland (899,800 tons /479,790/).

Of the satellite countries, Czechoslovakia received 1,819,400 tons of crude (1,392,400), East Germany 1,582,000 tons (1,107,000), Hungary 1,204,300 tons (1,085,500), and Poland 683,000 tons (553,900). Red China imported 635,900 tons of crude (672,000) and Outer Mongolia 27,200 tons (16,600).

Chief purchasers of Soviet oil products in 1959 were Red China (2,412,300 tons /1,835,300/) and Poland (1,097,700 tons /964,300/). Of western states, Sweden received 1,451,400 tons of products (870,300), Finland 965,500 tons (754,000), the United Arab Republic 1,391,100 tons (882,200), West Germany 824,900 tons (561,700), France 684,900 tons (529,600), Italy 675,600 tons (55,500), and Great Britain 101,800 tons (37,800).

In all, countries of the Sino-Soviet bloc received 5,951,800 tons of crude (4,827,400) and 4,834,800 tons of products (3,744,000); Western Europe received 4,806,800 tons of Crude (2,109,700) and 5,937,800 tons of products (3,946,100) while the remaining free-world countries received 1,726,700 tons of crude (2,155,400) and 2,007,800 tons of products (1,322,000).

During 1959 the Soviet Union imported 1,083,100 tons of crude (Austria: 1,012,200 ton /1,004,900/, and Albania: 70,900 tons /73,600/) and 3,339,400 tons of products (3,217,800).

USSR—An oil-shale deposit, estimated at 200 to 250 million tons, has been discovered in the south of Kirghizia. The oil-bearing layers approach the surface so closely that open pit mining is possible.

Dresser Purchases Podbielniak

H. N. Mallon, board chairman Dresser Industries, Inc., has announced the purchase of Podbielniak, Inc., Chicago.

Dr. Walter Podbielniak will continue to direct the company's activities and further technical developments.

Triple Frac-Notch Cutter

A new fracture initiation tool, the "Triple Frac-Notch Cutter," has recently been developed by McCullough Tool Co. In field operations, in hard sandstone and limestone formations, it has proved exceptionally efficient.

The Triple Frac-Notch Cutter operates on an electric wire line. It makes three separate notch cuts simultaneously on one run of the tool. Each notch cuts through casing and cement and cuts and fractures up to 15 inches into the surrounding formation.

The new tool is available for use in 2, 2½, 3 and 3½-in. tubing and in casing sizes ranging from 4½ OD through 7-in. OD.

New Log Checks Casing Cement

The new Schlumberger Cement Bond Log presents for the first time a recording of the quality of the casing cement job. Its operation is based on the fact that the energy of a sonic pulse transmitted along a casing diminishes rapidly where the casing is bonded to material, such as hardened cement, which has a sonic velocity much lower than that of the casing. By pointing to intervals where bonding is incomplete, even lacking entirely, the log indicates channeling and gaps in the cement column which require squeezing. At the same time, by denoting effectively cemented zones, the log saves the cost of many squeeze jobs formerly run to insure shut-off before testing.

Schlumberger engineers state that the log may be run at any time after the cement has set. In wells being worked over due to water production, the Cement Bond Log points out the probable sources of the water where caused by bad cementation. This information alone often enables profitable recompletion.

The Cement Bond Log can be run simultaneously with the Gamma Ray Log for correlation with open hole logs.

A. C. West

C. T. Jones

New Posts at O-C-T

A realignment of two top-level administrative positions at Oil Center Tool Co. has been announced by president W. A. Wolff.

Charles T. Jones has been named general manager, and A. C. (Bus) West, Jr. has been named sales manager. Mr. Jones' new responsibilities will be in addition to those of vice president. He had previously served as vice president and sales manager. Mr. West formerly had held the position of western region sales manager. President Wolff will devote additional time to working with other FMC (Food Machinery & Chemical Corp.) Oil Field Equipment Divisions. FMC is the parent company of Oil Center Tool.

Garrett's International Staff

John D. Millea has been named by Garrett Oil Tools, division of U. S. Industries, Inc. as a special sales engineer for Europe and the sterling currency areas. Mr. Millea will headquarter in The Hague, The Netherlands, and will assist C. M. Peters, vice president-sales engineering, in the firm's expanded sales activities in this area. Mr. Millea comes to Garrett from Servicios Petroleros, S. A. in Peru, where he was area manager. He was also formerly employed by Lobitos Oil Fields, Ltd. in Peru.

Trees Promoted by CB&I

George S. Trees has been elected a vice president of Chicago Bridge & Iron Co. Named a regional sales manager by the company earlier this year, he joined CB&I in 1939 and has served in several engineering and administrative positions. He was elected a director of the company in 1954.

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Ronald Gilbert, general sales manager, Goulds Pumps International, Inc., with Eric E. Backlund, vice president, Goulds Pumps, Inc.

Goulds International

Goulds Pumps, Inc., Seneca Falls, N. Y., has established a separate corporation, Goulds Pumps International Inc. to handle all export sales. Offices of the new company are located at 260 Madison Ave., New York 16, N. Y. The new arrangement covers all products manufactured by the 112-year-old manufacturer of pumping equipment, and includes both its complete line of jet and submersible type domestic water systems and its broad range of centrifugal pumps.

UOP Appoints Nelson

Edwin F. Nelson, 34-year veteran of the petroleum industry, recently rejoined Universal Oil Products Co. as a consultant for process sales and engineering. He first joined UOP in 1926 and was a vice president from 1945 to 1952. For the past eight years, he has been president of Lake Superior Refining Co.

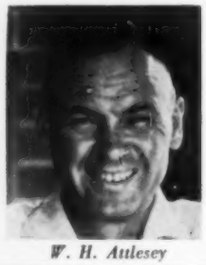
Primary vs. Secondary Recovery

Oil output from the big Spraberry area of West Texas will be increased ultimately by more than 186 million barrels as a result of the Texas Railroad Commission's approval of three secondary-recovery projects which will be undertaken by Sohio, Humble, and Southland Royalty Co. Engineers have estimated the Spraberry area will yield less than 10% of its crude reserves to primary production. Currently the subject of dispute among Texas oil men, secondary recovery is being argued as to whether production from such methods should be prorated in the same way as is primary production.

HOMCO Export Representative

W. H. Attlesey has been appointed export sales representative for the Houston Oil Field Material Co., Inc. He has been associated with the Superior Oil Co. as a seismologist, with Eastman Oilwell Survey Co. as a directional drilling engineer and held petroleum engineering posts with E. B. Hall & Co. (operators for the Union Pacific Railroad Co. Oil Division), Victory Oil Co. and Harvey-Williams Drilling Co. The latter assignment was in Brazil where he was a technical advisor to Petrobras, directing programs of production evaluation and exploratory drilling.

E F. Nelson



W. H. Attlesey

B-J Chairman Retires

Three presidents representing more than 47 years of Byron Jackson leadership are shown at the retirement of E. S. Dulin (left). Mr. Dulin served as president of the company from 1929 until 1958 and has been chairman of the board since 1945. John B. Keating (center) headed the company from 1913 until 1929, and Andrew W. Rose (right) has been president since 1958. The photo behind Mr. Dulin shows Byron Jackson, founder and company president from 1872 until 1913.

Goodyear Appoints Francis

D. H. Francis, now general manager of Goodyear Atomic Corp. at Portsmouth, Ohio, will become manager of all chemical products production, Goodyear Tire & Rubber Co., Jan. 1, 1961. Mr. Francis will direct selection of the management team for Goodyear's new synthetic rubber plant at Beaumont, Tex., and later this year will attend the Advanced Management Program at Harvard Business School. Moving up to replace Mr. Francis will be G. H. Reynolds who has ben manager of the production division at the subsidiary atomic plant. H. I. Belknap, who has headed Goodyear's chemical products production, will become a consultant for these operations.

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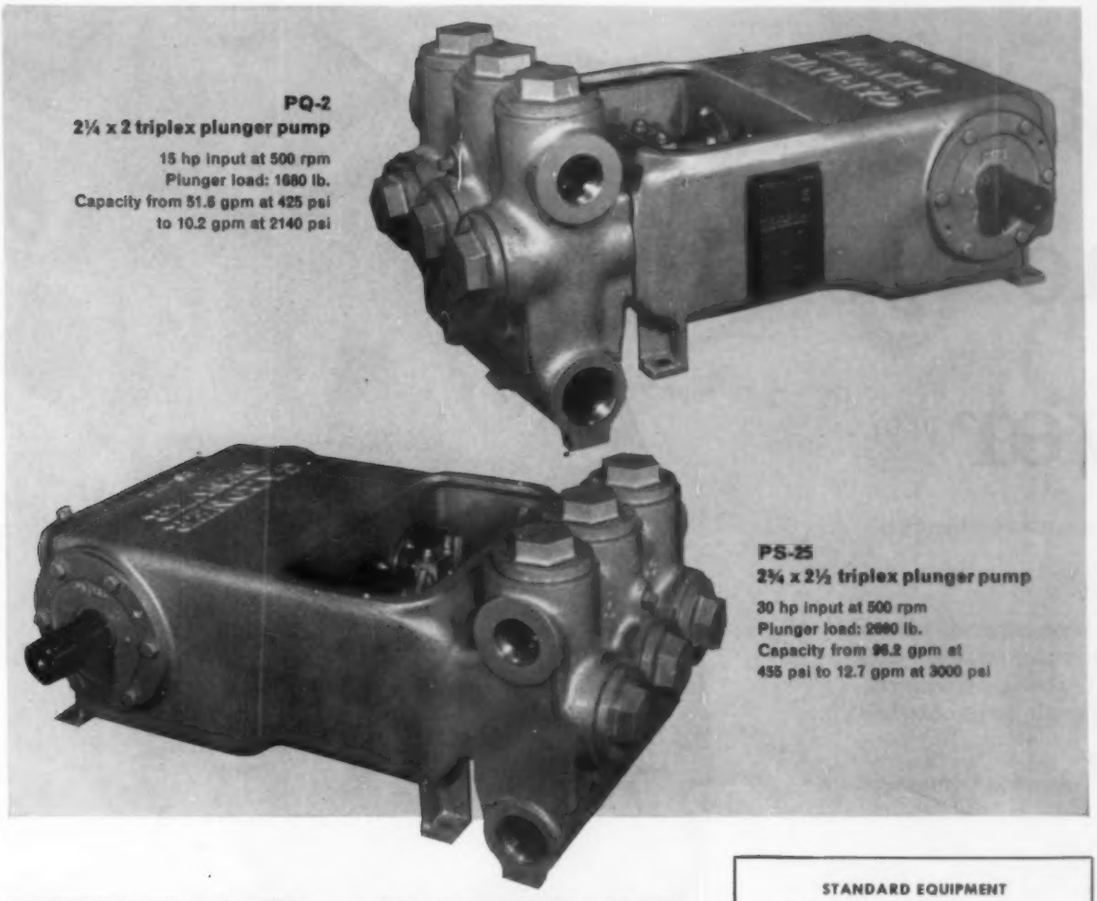

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World Petroleum Statistics

FREE WORLD SUPPLY AND DEMAND, CRUDE AND PRODUCTS, FEBRUARY, 1960

(Thousands of barrels)

Source: USA Bureau of Mines, Division of Petroleum.

Country	CRUDE PETROLEUM: Production	Imports	Exports and reexports	Stock change, other demand, and loss	Total 1/ refinery input / Total 2/ refinery output	REFINED PRODUCTS: Imports	Exports and reexports	Domestic demand (incl. bunkers)	Bunkers-all flags (as reported)
NORTH AMERICA									
Canada	15,908	8,997	3,696	-740	22,359	1,642	71	4/26,943	
Mexico	7,593	-	-436		8,534	561	1,122	7,973	
United States (incl. Alaska and Hawaii)	209,986	29,730	899	+5,537	246,584	29,377	5,505	4/301,456	6,873
Subtotal	233,487	38,727	3,995	+4,361	277,477	31,580	6,698	336,372	
CENTRAL AMERICA AND CARIBBEAN									
Costa Rica	-	-	-	-	-	E/ 98	-	98	
Cuba	15	E/2,000	-	+15	E/2,000	E/242	-	2,242	
Dominican Republic	-	-	-	-	-	E/188	-	188	
El Salvador	-	-	-	-	-	E/144	-	144	
Guatemala	-	-	-	-	-	E/274	-	274	
Haiti	-	-	-	-	-	E/ 72	-	72	
Jamaica	-	-	-	-	-	474	-	474	E/ 92
Nicaragua	-	-	-	-	-	E/127	-	127	
Panama, Canal Zone	-	-	-	-	-	631	169	462	448
Panama, Republic	-	-	-	-	-	E/265	-	265	
Puerto Rico	-	1,473	-	+81	1,580	559	561	1,578	
Subtotal	15	3,473	-	+96	3,580	3,074	730	5,924	
SOUTH AMERICA									
Argentina	4,051	1,977	-	-536	6,564	881	-	4/6,552	99
Bolivia	256	-	98	-7	171	11	1	181	
Brazil	2,158	1,742	594	+365	4,941	E/4,510	-	4/9,451	
Chile	545	374	-	-44	963	E/595	-	1,558	
Colombia	4,537	-	2,576	-198	2,234	E/ 24	201	4/1,516	E/115
Ecuador	280	-	-	-40	260	14	-	274	
Netherlands Antilles	-	28,197	-	-892	23,361	E/1,499	E/22,285	5/2,635	
Paraguay	-	-	-	-	-	E/ 61	-	61	
Peru	1,513	-	277	-180	1,432	307	190	1,549	29
Trinidad	3,413	2,498	420	-269	5,795	E/285	E/4,905	5/1,175	E/950
Uruguay	-	459	-	-297	736	770	-	1,526	E/ 78
Venezuela	85,437	-	57,736	+965	26,904	E/ 71	21,321	4/4,053	1,517
Subtotal	102,130	31,247	61,695	-513	73,381	9,028	48,843	30,531	
WESTERN EUROPE									
Austria	1,339	228	523	-33	1,127	574	114	4/1,466	
Belgium and Luxembourg	-	4,968	-	+565	4,478	2,230	1,803	4,905	346
Denmark	-	-	-	-11	11	2,975	5	2,981	137
Finland	-	1,398	-	+748	E/650	863	-	1,513	
France	1,072	17,017	-	-1,153	19,263	1,032	4,902	4/15,840	981
Germany, West	3,051	10,094	-	-1,640	14,785	5,499	1,224	19,060	408
Greece	-	565	-	-245	810	272	-	1,082	
Iceland	-	-	-	-	-	253	-	253	
Ireland	-	441	-	-221	662	170	-	832	42
Italy	912	17,137	103	-306	19,140	1,216	3,689	4/12,453	1,147
Netherlands	968	8,068	-	-1,326	11,041	2,480	6,761	6,760	835
Norway	-	58	-	-12	E/ 70	2,456	-	2,526	E/175
Portugal	-	1,008	-	-16	1,024	376	115	1,285	
Spain	-	1,865	-	-254	2,174	351	-	2,525	
Sweden	-	2,255	-	+619	1,636	8,263	210	9,689	E/247
Switzerland	-	-	-	-	-	2,224	2	2,222	
United Kingdom	50	28,183	-	+4,375	23,858	11,670	6,258	4/30,623	E/2,898
Yugoslavia	334	415	-	-35	784	E/102	26	860	
Subtotal	7,726	93,700	626	+1,055	101,513	43,016	25,109	116,885	
MIDDLE EAST									
Aden	-	47	-	-365	412	1,162	387	5/1,247	1,997
Bahrain	1,306	5,217	-	-145	6,747	137	4,940	5/1,944	415
Iran	29,698	-	18,131	+288	E/11,279	-	7,229	4,050	E/998
Iraq	26,720	-	E/25,584	-	E/1,136	E/ 1	-	1,137	
Israel	71	E/779	-	-	850	E/898	-	1,748	E/ 31
Jordan	-	-	-	-	-	E/ 96	-	96	
Kuwait	42,107	-	36,589	+14	5,508	E/ 2	2,062	5/3,448	2,156
Lebanon	-	451	-	-	451	E/ 28	-	479	E/ 67
Neutral Zone	3,613	-	E/1,800	+213	E/1,600	-	E/450	5/1,150	E/200
Qatar	5,323	-	E/5,305	-	E/ 18	-	-	18	
Saudi Arabia	36,128	-	28,787	+503	6,838	1	4,691	1,969	E/1,060
Turkey	226	-	-	+14	212	605	-	817	
U.A.R., Syria	-	E/457	-	-	E/457	5	-	462	
Subtotal	145,192	6,951	116,198	+528	35,508	2,935	19,699	18,565	
AFRICA									
Algeria	3,456	-	3,570	-114	-	1,030	-	4/904	
Angola	29	54	-	+2	81	63	-	144	
Belgian Congo	-	-	-	-	-	E/ 54	-	54	
Canary Islands	-	1,421	-	-146	2,093	103	1,597	5/599	429
Ethiopia	-	-	-	-	-	E/ 57	-	57	
Ghana	440	-	436	+4	-	E/178	-	178	
French West Africa	-	-	-	-	-	341	-	341	E/660
Ghana	-	-	-	-	-	291	-	291	
Kenya	-	-	-	-	-	E/451	91	360	E/ 76
Liberia	-	-	-	-	-	E/ 32	-	32	E/ 3
Madagascar	-	-	-	-	-	80	-	80	
Morocco	60	E/ 62	-	-	122	336	-	4/476	E/ 42
Nigeria	496	-	433	+63	-	433	-	433	
Rhodesia & Nyasaland	-	-	-	-	-	E/331	-	331	
Sudan	-	-	-	-	-	173	-	173	
Tanganyika	-	-	-	-	-	E/307	31	270	
Tunisia	-	-	-	-	-	321	-	4/250	
Uganda	-	-	-	-	-	E/ 85	15	70	
Union of South Africa	-	747	-	-59	806	1,845	222	2,429	
U.A.R., Egypt	1,717	E/1,000	237	-20	E/2,500	E/596	E/123	2,973	E/185
Subtotal	6,198	3,284	4,676	-270	5,602	7,107	2,079	10,445	
SOUTH ASIA, FAR EAST, AND OCEANIA									
Australia	-	6,681	-	-73	6,912	1,169	691	7,390	E/632
British Borneo	2,909	-	1,488	-	E/1,421	E/ 77	E/1,213	285	E/ 98
Burma	309	-	-	-4	313	E/ 9	3	319	
Ceylon	-	-	-	-	-	273	1	272	229
India	247	2,855	-	+165	E/2,937	1,282	176	4,043	E/230
Indonesia	11,146	E/647	4,313	+1,137	E/6,828	E/160	418	6,570	87
Japan	265	13,815	-	-1,023	15,526	1,801	247	17,080	
Korea, South	-	-	-	-	-	460	-	460	
Malaya and Singapore	-	-	-	-	-	3,516	1,507	2,009	972
Netherlands New Guinea	118	-	E/118	-	-	-	-	Insig.	
New Caledonia	-	-	-	-	-	E/ 34	-	34	
New Zealand	-	-	-	-	-	1,358	-	1,358	E/130
Pakistan	171	-	-	-46	E/217	E/924	-	1,141	
Philippines	-	727	-	-32	759	E/859	-	1,618	E/ 11
Taiwan	1	800	-	+155	646	E/ 12	-	658	
Thailand	-	-	-	-	-	591	-	591	38
Vietnam, South (incl. Cambodia)	-	-	-	-	-	E/461	-	461	E/ 3
Subtotal	15,166	25,525	5,921	+279	35,559	12,986	4,256	44,289	
WORLD TOTAL EXCLUDING EASTERN EUROPE, U.S.S.R., & MAINLAND CHINA	509,914	202,907	193,107	+5,530	532,626	109,726	107,414	563,011	

E/ Estimate based on latest available data.
1/ Total input includes crude runs to stills plus runs of other unfinished oils, topped crude and natural gas liquids blended.
2/ Total output includes refined product output plus refinery fuel and loss; excludes liquefied petroleum gases sold directly for fuel and chemical uses from natural gasoline plants.
3/ Unless otherwise specified, data represent apparent domestic demand (including inland demand, refinery fuel and loss, and bunkers). Apparent domestic demand is derived from the components of refined product output, plus imports, minus exports, with no allowance for changes in stocks.
4/ Domestic demand as reported, including refinery fuel and loss, stock changes, and bunkers; also includes, where available, liquefied petroleum gases sold directly for fuel and chemical uses from natural gasoline plants.
5/ Apparent domestic demand is heavily influenced by refinery fuel and loss, and bunker loadings.

Petrochemical Acetylene

(Continued from page 76)

ance of the three partial oxidation processes —(1) atmospheric, (2) at 4 atm pressure, and (3) at 4 atm with naphtha pyrolysis— is shown in Fig. 3 (based on 1,000 standard cubic meters of methane).

Acetylene and Ethylene from Liquid Hydrocarbons

A rational combination of ethylene and acetylene production from virgin naphthas (available at low cost from Italian refiners) has also been studied by Montecatini.

A commercial plant has been developed which can operate on liquid and/or gaseous hydrocarbon feed (see Fig. 4). In the reactor (6), the feed is burnt with oxygen. No danger of flashback being present, the combustion can take place under a pressure of several atmospheres, thus obtaining the advantages mentioned above.

To obtain a high thermal yield, complete combustion of the hydrocarbon feed must be achieved, by using gas/oxygen ratio close to stoichiometric ratio; to avoid overheating, a substantial amount of steam shall be added in the combustion reactor.

Oxygen and fuel gases, from the compressors (1-2) are charged to humidification columns (3-4). After preheating in (5), they are fed to the combustion reactor (6) with a controlled quantity of naphtha from pump (19). Naphtha to be cracked is injected through a series of nozzles (7) in the reaction zone (8). Due to the prevailing high temperature, acetylene production takes place. An additional quantity of naphtha is admitted through nozzles (9); this lowers temperature to 800 C, causing olefin formation in the zone (10).

Reaction products are finally quenched with water from nozzles (11). Hot water is pumped from the bottom by pump (15) to column (4), to saturate fuel gases. Gases from the reactor, through exchanger (13) and cooler (16), are sent to ethylene and acetylene recovery via line (14).

The process is very flexible, and allows variations over a wide range in the acetylene/ethylene ratio in the products. Naphtha of different compositions can be used, better yields being attained by use of normal parafinic feeds. END

Colombians Tour USA

Colombian petroleum engineering graduates on tour of USA oil operations visit Halliburton Oil Well Cementing Co.'s technical center at Duncan, Okla. Members of the 1960 class from the University of Industrial de Santander, Bucamaranga, shown above: front row, left to right; Pedro Camargo, Milton Ruiz, Jorge Gomez, Pedro Serrano, Jairo Gonzalez, Gilberto Barcenas. Back row; Professor Pedro Fernandez, assistant head of the engineering school, Roberto McCormick, Julio Gonzalez, Victor Castaneda, Policarpo Pico, Jose Villamizar, and Alirio Rurda.

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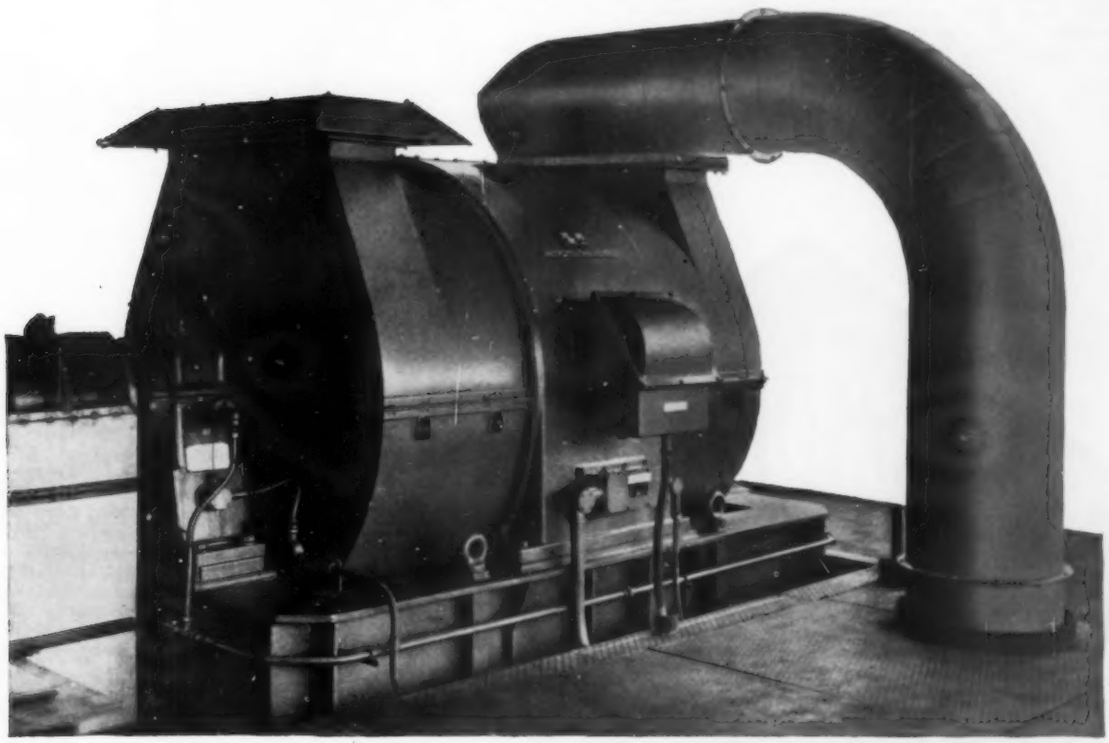

This 3000 hp., 1485 r.p.m., 3kV motor is the largest direct-on power-line started machine to be installed in a British oil refinery; it is a Type AMS, pipe-ventilated, squirrel-cage induction motor and drives the main air compressor on the Hydroformer unit at the Esso Oil Refinery, Fawley. A similar rated machine, but force-ventilated because of the hazard, drives a hydrogen compressor on the same unit.

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Raises Fuel Oil Import Quota

Residual fuel-oil import quotas were raised by the US Interior Department to 415,000 b/d for the fourth quarter of 1960. The winter month's quota for the heavy fuel used in factories and ships is 66% more than was allowed for the previous three months, and is about 5% under what had been imported in the 1959 winter period. An agency official said the new import figure is adequate to insure aganst shortages.

Gas to Cost More

Natural gas shipped through Pacific Gas & Electric Co.'s proposed pipeline from Alberta to California, scheduled for completion in the winter of 1961-62, initially will cost 5.9¢ per MCF more than gas purchased from the company's present supplier, El Paso Natural Gas Co. A PG&E spokesman said the extra costs "possibly" could mean the company will seek a "rate increase." PG&E finally won approval of the final phase of its $340 million project to import natural gas from Canada to northern California. The California Public Utilities Commission authorized construction of a 300-mile California segment of a proposed 1,400-mile Alberta-to-USA line.

US Federal Oil Output Up

Crude oil production on federal lands came to 253,986,236 bbl last year, a gain of 176% over the total of 92 million bbl just 10 years earlier, it is reported.

Some 35,774,800 bbl of this came from production on the outer continental shelf.

The Department of the Interior reported that there now are 159,135 leases on lands under its supervision, compared with 27,959 ten years ago; they cover 125,133,966 acres now against 20,327,509 ten years ago.

There now are 26,413 producible wells against 13,497 ten years ago.

U. S. crude oil pipe lines have a spare capacity of about 2,000,000 b/d, enough to take care of growing needs for some years, it is reported by Gordon C. Locke, general counsel of the Association of Oil Pipe Lines.

But, he adds, "more and more" product lines will be built until they reach "every large consuming city" in the country. The trend will be to larger lines. Crude lines will be converted to products service. And many miles of new lines will be built for LP-gas.

Mr. Locke sees more use of thin wall big-inch pipe, double welding of 40 ft lengths into 80 ft with mobile automatic welding rigs, more automation, better communications, and push-button control of flow.

U.S. Oil Imports Unaffected

Up to the present, at least, the oil import program has had little effect on the source of oil imported to the United States. Venezuela continues as the largest supplier of crude oil and products, supplying 51.6% of all imports in the first half of this year. In figures, this is 885,700 b/d out of a total of 1,715,000 b/d reported. This percentage compares with 52% of the total for Venezuela in the first nine months of the program, March through December, 1959. Then, Venezuela was the source of 785,800 b/d of a total of 1,512,200 b/d.

The Middle East as a group had 10.7% of the total in the first half of this year, against 10.12% last year, the figures show.

Saudi Arabia had 4.8% this year, up from 4% last year. Iran had 2.3% against 1.9. Neutral Zone had 2.1% against 3. Iraq had 1.1% against 1.2% Bahrein had 4% against 2%. Canada went up from 6.4% last year to 7.1% this year, with the Canadian exemption. Colombia was steady at 2.3%. Over the long run, there may be shifts, but the figures available today do not reflect any marked shift from one source to another.

Houdry and Huels Combine

Chemische Werke Huels A.G. has joined with Houdry Process Corp. to form a new subsidiary to be known as Katalysatorenwerke Houdry Huels GmbH, to be located at Marl/Kreis Recklinghausen, Germany. Each company will contribute 50% of the capital in the new enterprise, which is being built to take care of the rapidly increasing western European demand for catalyst for petroleum, chemical, and petro-chemical processing.

Chemische Werke Huels has also announced it will build a new plant for the manufacture of 20,000 ton/yr of polybutadiene.

Fluor Sells Interest in Acres

The Fluor Corp. has sold its 60% interest in H. G. Acres & Co. of Niagara Falls, Ont., to Conseco Ltd., a holding company formed by 21 senior members of the Acres organization, for an amount in excess of $1 million.

Fluor had purchased majority control of Acres in 1953 to establish refinery and petro-chemical engineering staff in Canada, but has been engineering its Canadian projects at Los Angeles for past two years. An informal agreement was made to call on Acres should the need arise in the future.

Erratum

In the tabulation of first half oil company earnings on Page 118 of the September issue the column heading for 1960 was transposed with 1959. Result was that this year's earnings were shown as those for the first half of 1959 and viceversa. Earnings of British American Oil Co. were given as $1.41 per share whereas the correct figure was $0.41.

Erratum

In the August issue of WORLD PETROLEUM on Page 89 reference was made to the estimate of world crude reserves made by Dr. L. C. Weeks some 20 years ago, the figure being stated as "$10 billion" barrels. Aside from the typographical error, which should have read "610 billion barrels" Dr. Weeks points out that his estimate of 20 years ago did not include oil from water areas of the world which will no doubt produce several hundreds of billions of barrels, nor natural gas liquids. The original estimates were made to quantitatively rate the world's basins and were not prepared for the purposes for which they have been used and were not published by him but by others.

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E. H. Growth Poses Problems

Growth in Eastern Hemisphere oil operations is analyzed in a study by the 1st National City Bank of N. Y., which shows that approximately 100 American companies now have oil interests in the Eastern Hemisphere—with another 100 active outside the USA in the Western Hemisphere. In the five years 1953-58, Eastern Hemisphere crude production increased to 7.8 million b/d from 4.3 million b/d, an 80% increase.

By comparison, crude output in the Western Hemisphere in the same period increased only about 13%, to something over 10 million barrels daily in 1958 from less than nine million in 1953. The study concludes that, as a result of the limitation on oil imports by the USA, American companies having crude production in foreign countries face the finding of other markets for a great part of their oil; and the recent decreases in the price of foreign crude indicate oil produced abroad will not be so profitable as in former years. Furthermore, many of the "newcomers" to international oil finding will have to consider investing in their own marketing facilities (i.e., nonproducing facilities) in order to have outlets for much of the oil they have discovered.

According to the study, Eastern Hemisphere oil demand (communist included), plus exports, totaled 4,875,000 b/d in 1953, rose to 8,575,000 by 1958, and is forecast to reach 12,250,000 b/d by 1963. Crude production, which in 1953 totaled 4,300,000 b/d, by 1958 had risen to 7,750,000 b/d, and is expected to reach 11,550,000 b/d by 1963. Imports of crude and products in 1953 totaled 600,000 b/d, rose to 825,000 b/d by 1958, and are forecast to reach 700,000 b/d by 1963. Thus, according to the City Bank survey, total Eastern Hemisphere oil supply in 1953 was 4,875,000 b/d; in 1958, it was 8,575,000; and by 1963 should rise to total 12,250,000 b/d. Refining capacity in the "free" Eastern Hemisphere was 3,400,000 b/d in 1953, with refinery runs of 2,650,000 b/d; by 1958, capacity had risen to 5,885,000, with runs at 4,600,000 b/d. By 1963, refinery capacity is to rise to 7,700,000, with refining runs at 6,800,000 b/d.

Pertinent Eastern Hemisphere oil statistics from the study are given in the following table:

Total Eastern Hemisphere Petroleum Statistics

(Thousand Barrels Per Day)

	1953	1956	1958	1963 Forecast
Consumption of Crude and Products:				
Free E. H.	3,150	4,725	5,400	7,600
Communist	1,250	1,975	2,450	3,775
Total E. H.	4,400	6,700	7,850	11,375
Total Exports (mostly crude)	325	475	600	775
Total Demand	4,875	7,150	8,575	12,250
Crude Production				
Free E. H.	2,900	4,125	5,125	7,350
Communist	1,375	2,075	2,625	4,200
Total E. H.	4,300	6,200	7,750	11,550
Imports:				
Crude	100	300	225	200
Products	500	650	600	500
Total E. H.	600	950	825	700
Total Supply	4,875	7,150	8,575	12,250
Communist:				
Imports from Free E. H.	—	30	20	25
Exports to Free E. H.	35	115	210	400
Free Eastern Hemisphere:				
Refining Capacity	3,440	4,800	5,885	7,700
Refinery Runs	2,650	3,950	4,600	6,800

BP Sales Rise in First Half

Net group sales and other income reported by The British Petroleum Co. Ltd. for the first half of 1960 amounted to $895,992,000 compared with $825,583,000 for the same period a year ago, according to the company's new semi-annual statement.

Net income of the BP group for the six months ended June 30, 1960 totaled $88,127,000, equivalent to 42 cents on each of 210,244,820 ordinary stock units of £1 currently outstanding. This compares with earnings of $86,691,000, or 43 cents on each of 202,401,340 ordinary stock units outstanding on June 30, 1959.

Sales of crude oil and refined products of the BP group for the first half of this year amounted to 261 million barrels as against 227 million for the like period a year ago.

In releasing its statement, the company pointed out that transactions with non-group companies of a reciprocal nature, previously included both as sales and purchases, are now wholly excluded. Figures for the first half of 1959 and for the year 1959 have been correspondingly adjusted.

The figures for taxation comprise overseas liabilities for the first half of 1960 of $124,970,000, and for the first half of 1959 of $115,934,000, less estimated United Kingdom tax credits amounting to $16,800,000 and $21,000,000, respectively.

D & D Club of Houston

Desk and Derrick Club of Houston elects 1960-61 officers. Seated—left to right are: Miss Eleanor Wirfel (King and Heyne), first vice president. Miss Myrtle Heise (Humble Oil and Refining Co.), president.

Standing—left to right are: Miss Mildred M. Carroll (Texaco Inc.), recording secretary. Mrs. Claudia Branch (Atlas Pipe, Inc.), treasurer. Mrs. Elizabeth Rockwell (Gulf States Asphalt Co.), second vice president. Miss Margaret Gust (The Superior Oil Co.), corresponding secretary.

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Seismic contractors experienced in the use of Hawthorne "Blue Demon" Bits know it's just as easy to get, and economical to use patented "Blue Demons" anytime, anywhere around the exploration world. They insist on "Blue Demons" because:

- Basically high quality of original design and manufacture assures superior performance everywhere, everytime . . .
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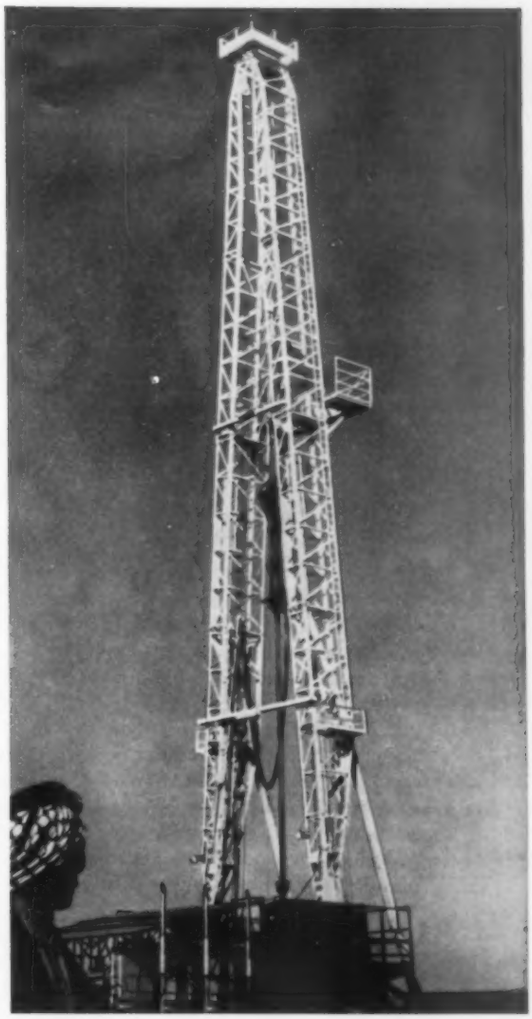

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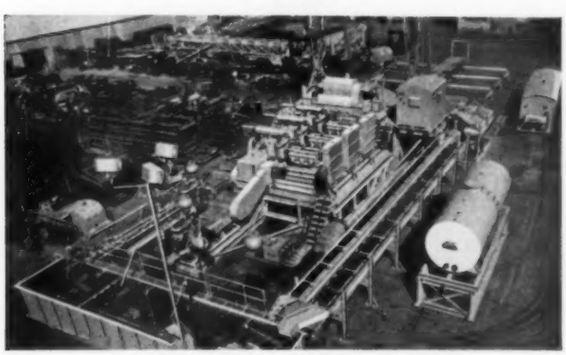

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New Westinghouse Motor Starter Has six features For Greatest Safety

Latest addition to the Westinghouse line of motor starters, the new NEMA 12 Life-Line combination starter has been developed by Westinghouse to provide far greater personnel safety, discourage tampering, and yet be readily accessible for maintenance. For example:

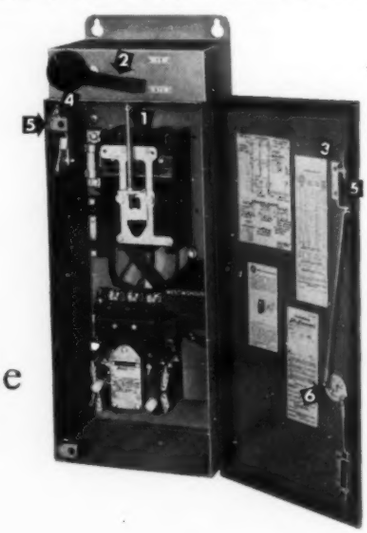
Disconnect is permanently attached by tie rod (1) to On-Off handle . . . is *not* disengaged by opening door. This assures complete safety when handle is padlocked (2) to prevent operation.

Door must be fully closed and sealed (3) before On-Off handle will operate disconnect. However, safety release (4), fully clear of exposed electrical parts, permits operation of On-Off handle and disconnect with door open.

Interlock assembly (5) prevents door from opening when handle is at On. (If desired, this feature can be defeated by removal of spring from assembly.) Door can be opened (6) only with screwdriver – not bare hands – preventing unauthorized tampering.

Other features: molded nylon handle, dustproof enclosure, ample internal wiring space for extra overload relays and excess capacity transformer, full accessibility from front, and standard Westinghouse quality components throughout.

This new starter is obtainable in five sizes of three models for different voltage needs. In addition, a complete range of other types of motor controls comes from Westinghouse. For more information, see your Westinghouse distributor. Or write for Catalog 60-C, Westinghouse Electric International Co., 40 Wall Street, New York 5, U.S.A.



YOU CAN BE SURE... IF IT'S Westinghouse

(Continued from page 64)

it is associated with propionaldehyde, acetone and water. The relative volatility for the separation of acrolein from acetone is approximately 1.12 in the absence of a solvent. The presence of water has been found to increase this relative volatility markedly. It is therefore feasible to separate acetone from acrolein by extractive distillation, using water as solvent.

The relative volatility for the separation of propionaldehyde from acrolein in the absence of a solvent is also found to be about 1.12. Here, again, the presence of water in the system introduces a greater spread.

Pierotti[23] states that the relative volatility of propionaldehyde/acrolein attains a value of about 1.4 in the presence of 90 wt-% water at atmospheric pressure. This alpha value can be increased still further by operating at elevated pressure.

These findings provide the basis for a two-step extractive distillation process for removing from acrolein the two key impurities, acetone and propionaldehyde, wherein water is employed as solvent. This approach is illustrated in Fig. 1.

The crude acrolein-containing bottoms from the acetaldehyde fractionators are subjected to the first extractive distillation in the presence of water under the following conditions: top column temperature, 74C; bottom column temperature, 85C; top column pressure, 1,436 mm Hg; bottom column pressure, 1,586 mm Hg; water content of column, 83 wt-% of total liquid on trays in column; reflux ratio, 59/1; and reflux/feed ratio, 2.47.

Composition of the crude-acrolein charge and the products of the distillation are indicated as follows:

	Extractive Distillation			
	Crude Acrolein Feed to Fractionator Wt—%	Feed Bottoms from Crude Fractionator Wt—%	Overhead[1]	Bottoms[1]
Acrolein	90	95.7	47.0	97.8
Propionaldehyde	2.0	2.15	53.0	0.2
Acetone	2.0	2.15	0.1	2.24
Acetaldehyde	6.0	0.2	0.5	0.2
Water	(3-6)	(3-6)	(3-5)	(92.7)

[1] Water-free basis.

The bottoms from the first extractive distillation now free of any substantial amount of propionaldehyde are subjected to a second extractive distillation in the presence of water under the following conditions:

	Low Pressure
Top column temperature, °C	—9.7
Bottom column temperature, °C	20
Kettle temperature, °C	48
Top column pressure, mm Hg abs	50
Bottom column pressure, mm Hg abs	100
Water maintained in col. in { 83.0 above feed inlet wt-% of total liquid on tray { 94.1 below feed inlet	
Reflux to feed ratio (on water-free basis)	0.4

The composition of the overhead and bottoms of the column is indicated in the following table:

	wt-% in:	
	Overhead	Bottoms
Acrolein	99.6	9.0
Acetaldehyde	< 0.1	—
Propionaldehyde	< 0.1	—
Acetone	< 0.1	91.0
Water	0.4	(99.87)

In the distillative recovery of acrolein from other aldehydes, polymerization of the unsaturated aldehyde may occur which can lead to obstructions in the fractionation columns. This difficulty has been traced largely to the presence of oxygen in the system. To eliminate this difficulty, it has been proposed[24] to boil the aqueous solutions prior to distillation at sub-atmospheric pressure (100 mm Hg), and at a pH between 6 and 7.

Residence time of 2-3 minutes at the boiling point in a packed column is reported to be sufficient to expel the oxygen contained in the solution, while not more than one percent of the aldehyde is hydrated in the course of this step. Further protection against polymerization is provided by addition of a small amount of inhibitor such as hydroquinone, and by preventing further access of air to the recovery system. END

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From simple manual devices to complex systems for completely automatic operation, Westinghouse supplies dependable equipment of advanced design for the many control needs of petroleum producers and refiners.

This modern control room for a large product pipeline is but one example. Its Westinghouse controls and indicating instruments are centralized for efficient operation. On the main console is push-button sequence control for seven pumping units at the station. The diagram panel on left wall provides supervisory control of a booster station located 56 miles downstream on the pipeline.

Besides a complete line of controls, Westinghouse manufactures thousands of other products for the varied operations of the petroleum industry. Among them: gas turbines for power generation, pipeline pumping and repressurization . . . motors for oil well pumping, pipelines, drilling . . . microwave systems for communication and remote control of pipeline stations . . . steam turbine-generator units for power and process steam . . . and many more.

NEW PUBLICATIONS

U. S. Bureau of Mines has published a 538 page book, *Petroleum and Natural Gas Fields in Wyoming*, with 171 maps and analyses of 418 crude oil samples. Copies may be had for $4.25 from Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Crossroads, Land and Life in Southwest Asia, by George B. Cressey. A detailed book on the Middle East which covers geography, culture, land use and, in one chapter, oil development, plus other recent happenings and history. There is one chapter for each country of the area, as well. Many illustrations and some useful statistics. Published by J. B. Lippincott Co., 227 S. Sixth Street, Philadelphia 5, Pennsylvania, USA. Price: $12.00.

A Century of Oil and Gas in Books by E. B. Swanson. An exceptionally useful compilation of the books and periodicals published in the USA and treating with oil and gas. Covers some 2,000 items, giving the title, author, date of publication, a brief description and report. An index of authors' names is contained. Sponsored by the American Petroleum Institute. Highly recommended. Available through Appleton-Century-Crofts, Inc., New York. Price $4.75.

Petroleum and Natural Gas Fields in Wyoming by Paul Bigga and Ralph H. Espach. Published by the U. S. Bureau of Mines, Washington 25, D. C. A 542-page book on oil and gas, with a number of maps and detailed description of all fields.

Unfired Pressure Vessels, by Robert Chuse, the only handbook ever written to simplify ASME Code requirements, has just been published in an enlarged, revised fourth edition. The book includes 66 tables, charts and diagrams permitting quick, accurate calculations for designing, ordering, fabricating, inspecting and repairing unfired pressure vessels. It is not a text-book, but a practical work book for consulting mechanical, chemical and design engineers, and for fabricators, inspectors, shop supervisors and users of Code vessels.

This fourth edition has been enlarged, revised, and updated to include current requirements of Section VIII Rules for Construction of Unfired Pressure Vessels, and of Section IX on Welding Qualifications of the ASME Boiler and Pressure Vessel Code. Written in an easy to understand manner, this compact book brings in condensed form all the useful information gained by the author in 24 years of evaluating ASME Code design as an inspector for an inspection and insurance company.

Robert Chuse is a commissioned inspector of the National Board of Boiler and Pressure Vessel Inspectors, and the States of Massachusetts, New York, Ohio and Pennsylvania. He is a member of the American Welding Society and the Pennsylvania Schoolship Association. A Marine Engineer graduate of Pennsylvania State Nautical School, Mr. Chuse also taught Stationary Engineering at Mondell Institute, New York. He has written many articles for the trade and technical press. His basic paper on "Welding Qualifications Inspection" is now part of the course given by the Canadian Welding Bureau.

The book recounts the history of the ASME Code, outlines procedures for obtaining Code authorization, presents Canadian pressure vessel requirements, indicates necessary procedures for welded repairs and highlights such important managerial factors in handling Code work as work-flow schedules, mill orders, warehouse orders and shop organization. Included in the 66 tables and diagrams are simplified charts for internal and external pressure, for shell and head thickness, for flat head and coverplate thickness, for thickness, pitch and pressure requirements for strayed surfaces, for simplified calculations for openings and reinforcements, plus a calculation sheet that makes the openings and reinforcement problems easy, clear and concise, and a descriptive index that gives a pictorial view of all types and parts of a Code vessel.

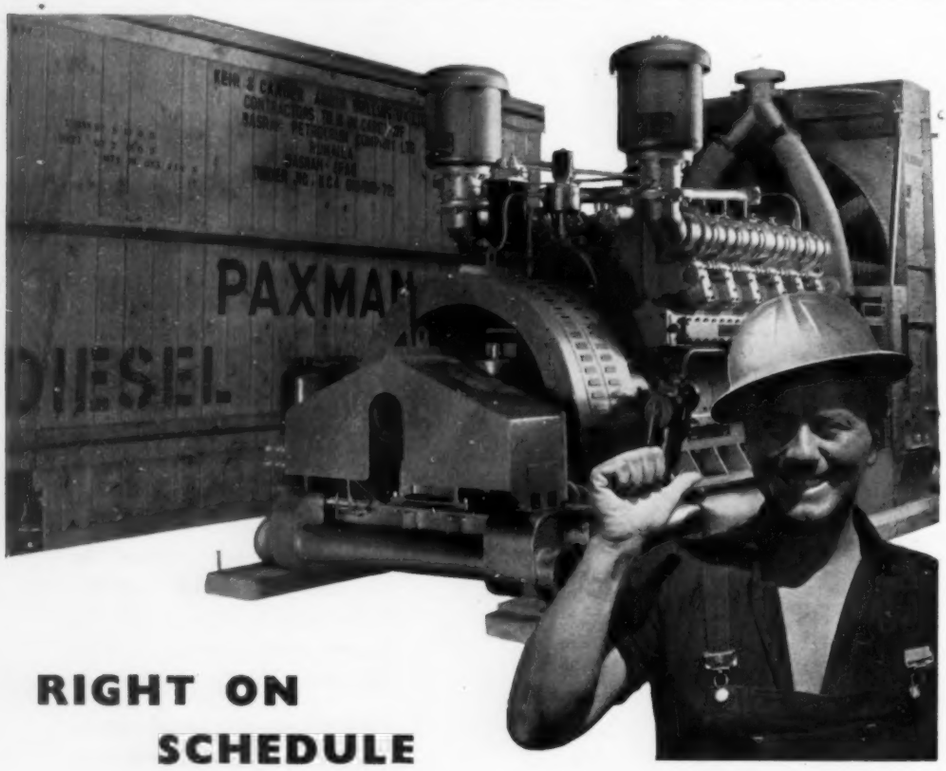
"Unfired Pressure Vessel," 149 pages, $8.75. F. W. Dodge Corp., 119 West 40th Street, New York 18, N. Y.

"Corrosion Problems of the Petroleum Industry"—The nine papers and the discussions at the November 1959 symposium on these subjects organized by the Institute of Petroleum and the Society of Chemical Industry are now published as SCI Monograph No. 10. This is available from the society at 14 Belgrave Square, London, S.W.I., price 30s. (22 s. 6d. to members of either body).

"Tables for Petroleum Gas/Oxygen Flames: Combustion Products and Thermodynamic Properties"—This work by I. I. Berenblut and Anne B. Downes of Shell International Petroleum Co. presents tables (worked out by Royal Dutch/Shell electronic digital computer and calculated by a variation of the US. Bureau of Mines' method) of the composition and their thermodynamic properties over a wide temperature range, as well as the adiabatic flame temperatures, of a selection of rich LPG/oxygen flames.

Following a 6-page introduction (with selected references and a chart showing graphically the relationship between flame temperature and oxygen/fuel volume ratio for all the LP gases considered) there are the following tables: (1) Summary of information on theoretical flame temperatures for seven LPG fuels over a range of oxygen/fuel ratios; (2) Equilibrium composition and thermodynamics properties of rich LPG/oxygen flames (7 pages); and (3) Equilibrium composition and thermodynamics properties of combustion products for various oxygen/fuel ratios (from 2.5 or 3.0 to between 4.5 and 6.5).

The tables which fulfil a need in a very practical way for workers on heat transmission problems, are published by Oxford University Press, Amen House, Warwick Square, London, E.C.4, price 30s net.



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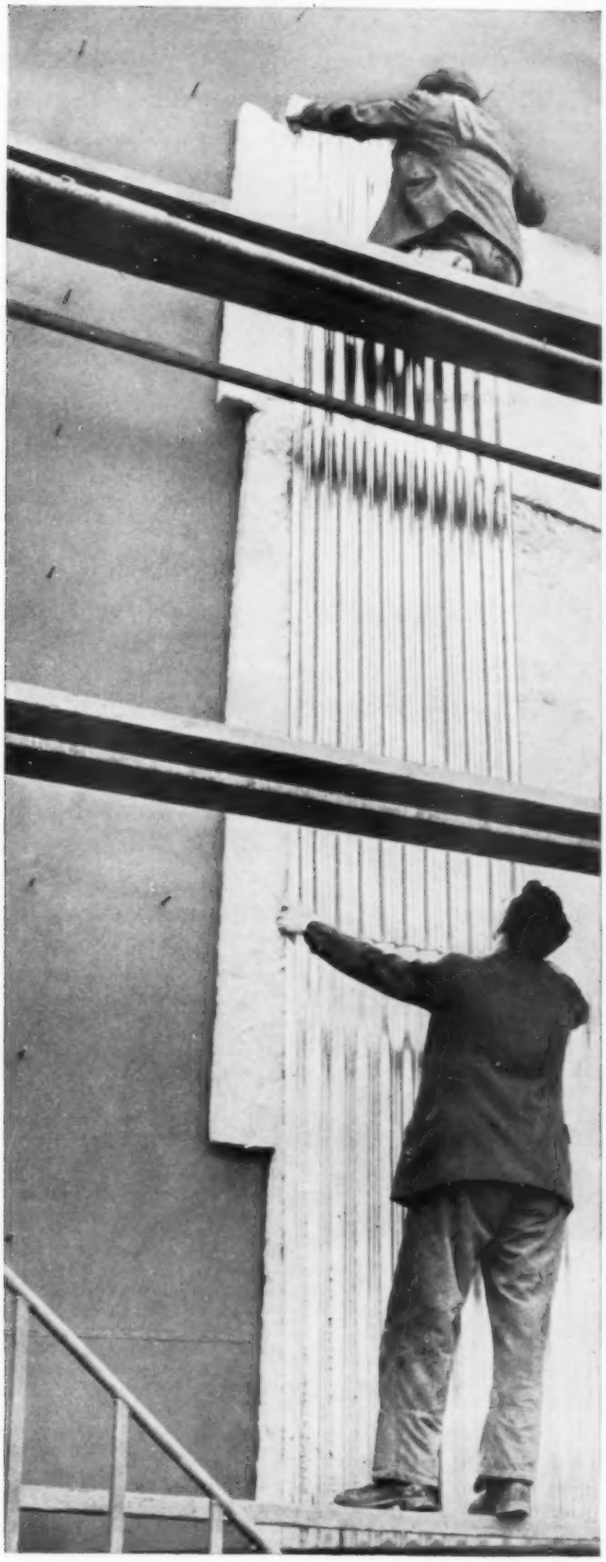
Los Angeles Nomads Guests

International guests at the August 10, 1960 meeting of the Los Angeles Chapter of Nomads. Left to right (front row) Stan Nelson of D & E from Iraq; E. E. Lay of Qatar Petroleum Co. from Qatar; George A. Waters of Qatar Petroleum Co.; Paul Hughes of Ralph M. Parsons from Ethiopia; (back row) Everett Forte of Esso Standard from Libya; J. W. Killingsworth of Iraq Petroleum Co. from Kirkuk; Mel Cooper of Volco, Inc. from Colombia; R. B. Hearne of Caltex from Sumatra.



Esso adopt Fibreglass Crown with Stud Welding Technique

This tank at Esso's Tynemouth terminal is getting the latest in insulation treatment—Fibreglass Crown with Stud Welding Technique. This has been devised jointly by Crompton Parkinson (Stud Welding) Limited, makers of 'Setlok' Studs and Fibreglass Limited, makers of Crown insulation.

Fibreglass Crown with the Stud Welding Technique has four main advantages over the methods it replaces. It costs considerably less; it is quicker; it is easier to apply; and it provides better insulation.

Fibreglass Crown with its special attributes—not the least important its exceptional tear strength—is particularly suitable for this method of insulation.

Good enough reasons for writing for further details?

Contractors
Miller Insulation and Engineering Ltd.

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TELEPHONE: ST. HELENS 4224

Europe and Southwest Link

A direct link between manufacturers in the Southwest and their markets in Western Europe has been formed by Rives, Dyke and Co., Inc., Houston advertising agency, through a unique association known as PLAN International.

Rives, Dyke, is the first corresponding member of the association in the USA. Member advertising agencies are located in Germany, England, Belgium, Denmark, Spain, France, Holland, Ireland, Italy, Norway, Portugal, Sweden, and Switzerland.

The association differs from a "branch" operation in that member firms are already well established and well known, staffed with citizens of each country thoroughly familiar with their country's market situation. Otherwise, actual operation would be similar to a branch in that it would provide competent, on-the-spot service in a foreign locale. When a Rives-Dyke client wishes to expand his marketing operations to, say, Germany, the agency will contact the PLAN International member in Germany, requesting market information on the product or service the client will offer in that country. The member agency will then make the necessary market research, select media, establish a public relations program, and handle advertising copy writing, making certain that laws relating to advertising are followed and that translations are accurate and in good colloquial language.

General Geophysical Names Penny

C. W. Penny has been appointed vice president and general manager of General Geophysical Co. (Bahamas), Ltd., Tripoli, Libya.

He has been vice president and general manager of the firm's South American subsidiaries in Caracas, Venezuela, and Bogota, Colombia, since 1956. He was supervisor of General's Louisiana geophysical operations from 1954 to 1956. Mr. Penny joined General in 1947.

New Esso Tanker Launched

The new Humble Oil & Refining Co. tanker "Esso Baltimore," designed to be the most efficient bulk oil carrier for United States Gulf and East Coast operations, recently was launched at Newport News, Va. Flying the USA flag and modern in every respect, the new 47,400-ton vessel can carry about 330,000 bbl of cargo.

To Develop Gas Reserves

Texaco Inc. has made an agreement to explore for and develop oil and gas reserves on all of Louisiana Land & Exploration Co.'s unleased fee lands in South Louisiana. An estimated 400,000 acres are covered by the agreement, which runs for six years during which Louisiana Land will receive $3,940,000. Oil or gas, if produced, will be owned 40% by Louisiana Land and 60% by Texaco.

New Pipeline Planned

Ten major oil companies plan a $19 million oil products pipeline from Chicago area to Milwaukee and north to Green Bay, Wisc. The 200-mile line initially would supplement the lake tankers now serving these Wisconsin areas and eventually would replace tanker transportation. Capacity initially would be 150,000 b/d to 175,000 b/d of oil products. Line is expected to reduce considerably the constantly rising tanker transport costs.

The ten participating companies are Standard of Indiana, Socony Mobil, Shell, Texaco, Cities Service, Pure Oil, Continental Oil, Ohio Oil, Clark Oil & Refining, and Pate Oil Co. (a division of Humble Oil & Refining).

$58 Million Gas-line Project

FPC has approved applications of four natural-gas pipeline companies for construction of $58 million of new storage and transmission facilities. Texas Eastern Transmission will spend about $40,668,000 for midwestern and eastern facilities. Also jointly with Transcontinental Gas Pipe Line and New York State Natural Gas Corp., Texas Eastern will spend estimated $8,022,400 for Leidy storage in Pennsylvania. Algonquin Gas Transmission will spend $5,502,200 in Massachusetts.

API Medal To Holman

Eugene Holman, former president and board chairman of the Standard Oil Co. (New Jersey), has been named the 1960 recipient of the American Petroleum Institute's "Gold Medal for Distinguished Achievement." The award, considered the oil industry's highest tribute, was presented at the Institute's 40th annual meeting in Chicago. M. J. Rathbone, president and chief executive officer of Jersey Standard and chairman of the API's board of directors, presided at the ceremony.

Mr. Holman spent some 40 years in the oil industry before retiring from Jersey Standard May 1 of this year. After receiving a master's degree in geology, he went to Cuba with an oil exploration party in 1917. Following service in World War I as an aerial photographer, and a brief post-war job with the United States Geological Service, Mr. Holman joined the Humble Oil and Refining Co., then a Jersey Standard affiliate, as a geologist. That was in 1919. Ten years later, after becoming the company's chief geologist in Houston, he was transferred to New York as an assistant to E. J. Sadler, then a vice president of Jersey Standard in charge of crude production. In this position his earlier exploration work in Mexico, Cuba and the West Indies led him to a keen interest in foreign producing problems. He later served as president and director of Creole Petroleum Corp. and Lago Petroleum Corp., Venezuelan affiliates of Jersey Standard.

Mr. Holman became a director of the company in 1940. Two years later he was elected a vice president and then a member of the executive committee. He became president in June, 1944 and chairman of the executive committee in January, 1946. He assumed chairmanship of the board of directors Jan. 1, 1954. Mr. Holman was born in San Angelo, Texas in 1895. He now lives in New York City. He becomes the twelfth recipient of the API's Gold Medal which was last awarded in 1958 to W. S. S. Rodgers, former president and board chairman of The Texas Co.

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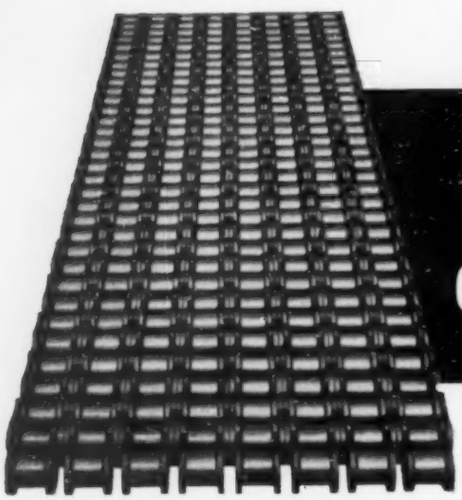
In 1880 Hans Renold invented and patented the bush roller chain . . . in 1895 he invented and patented the inverted tooth or silent type of chain. That's why, when you buy a Renold chain, you not only buy a chain incorporating all the most modern manufacturing techniques but **you buy something no other chain manufacturer in the world can give—the accumulated knowledge of 80 years' chain-making experience.**



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WELL, WHAT IS IT?

(To be fair we should point out that the domed top and fabricated cantilever are part of a test rig. The thing in question begins at the weld below the lettering).

Unless you happened to see, in an earlier advertisement, the cardboard model in which the idea took shape, memory will be no help. This is something quite new.

It is an expansion joint, one of 72 such joints that will take up the expansion of the CO_2 ducting at the Trawsfynydd Atomic Power Station. Internal pressure 265 p.s.i., temperature 420°C.

The convoluted bellows holds the internal pressure; the end thrust—over 1,000,000 lb.—is taken by the inclined, high-tensile steel bars round the periphery; flexing is entirely by elastic straining of these bars. The illustration shows the joint being prepared for the Insuring Authority's acceptance test—1,250 full deflections under full internal pressure and temperature. Compared with previous joints for this kind of work it is lighter, simpler, cheaper. It is the kind of highly original solution to both new and old problems that Richardsons Westgarth engineers can, and frequently do, produce.

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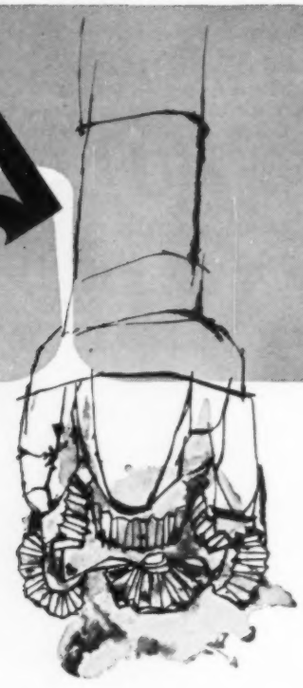

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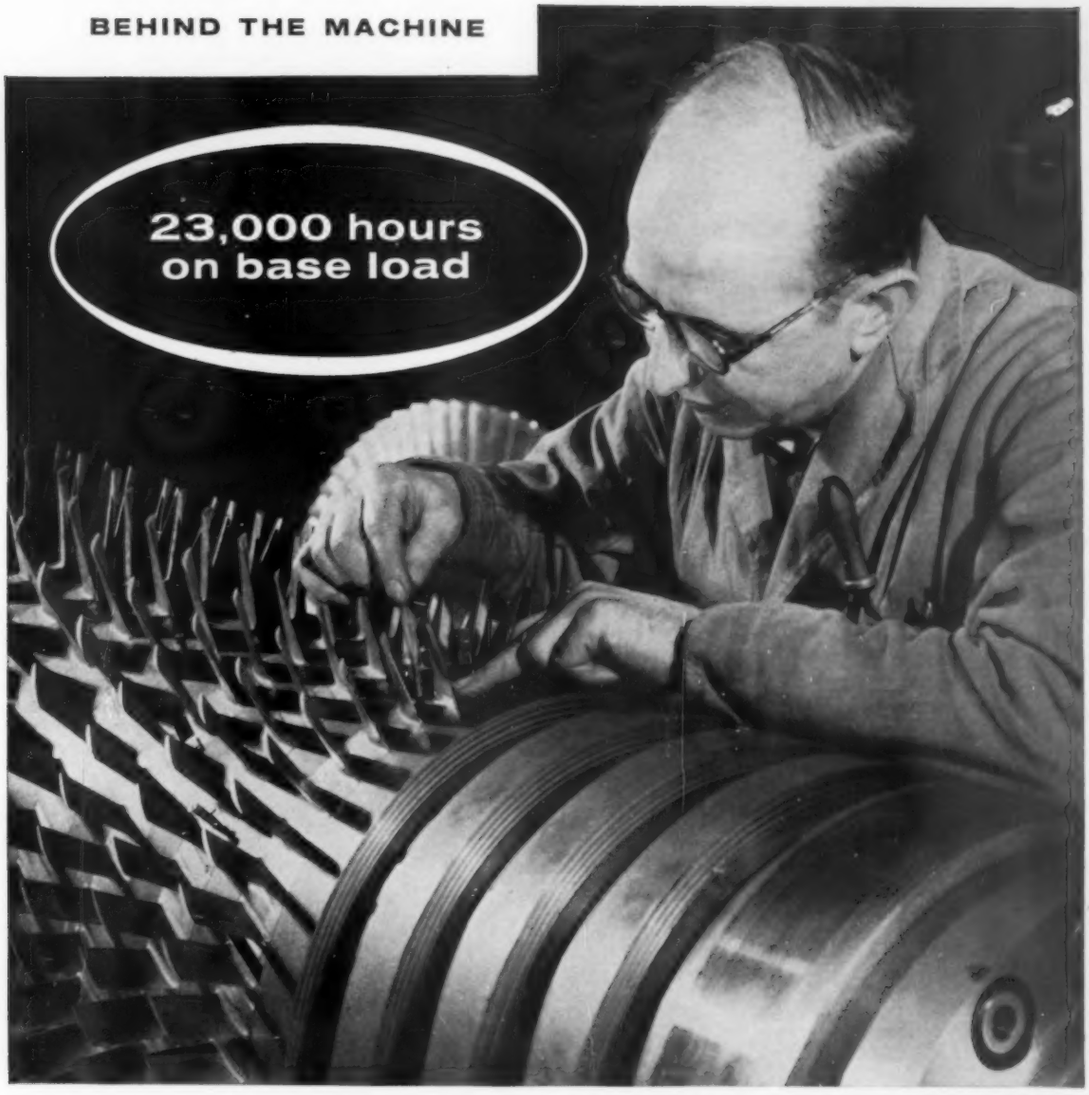

The proved reliability of AEI industrial gas turbines is typified by a machine in Venezuela which has recently completed 23,000 hours running on base load. AEI makes a range of industrial gas turbines with ratings from 1,750 kW upwards designed to run on gaseous or liquid fuels.

The picture shows work on the compressor rotor of L2IC gas turbines being built, at the AEI Turbine-Generator Division Factory for the Basrah Petroleum Co. These feature a single shaft design which ensures stable regulation and makes them particularly suitable for parallel operation with other generating equipment.

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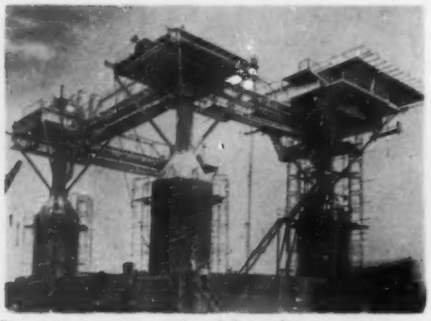

First of a new type of mobile underwater oil storage unit is seen at the Bethlehem yard just prior to completion.

Underwater Oil Storage

The first of a new type of mobile underwater oil storage unit has been completed by Bethlehem Steel Co.'s Beaumont shipyard. Designed and built by Bethlehem, the new unit will store 20,000 bbl of crude oil 25 ft. below the waters of the Gulf of Mexico. The basic design of the facility can be adapted to units capable of storing 1,000,000 bbl in water as deep as 200 ft.

The first Bethlehem Mobile Underwater Oil Storage Unit, as it is known, consists of a rectangular tank 112 ft. by 92 ft. by 10 ft. Divided into five compartments, this tank will rest beneath the water's surface with its top flush with the Gulf floor. To accomplish this, the area where it is to operate is being dredged 10 ft. Four steel tubes, 18 ft. in diameter rise from each of the tank's four corners. The upper sections of the tubes are five ft. in diameter. These tubes provide stability in the sinking and raising operations, additional oil storage capacity, and support for four platforms 33 ft. above the water, high enough to be safe from hurricane waves.

One of these platforms provides living quarters for a crew of up to ten men. The others contain production equipment and a heliport.

To discharge the oil, sea water will be pumped in at the bottom and the oil will rise on top of the water to discharge lines. These lines are capable of discharging oil at a rate in excess of 2,000 bbl/hr. Carefully devised controls prevent oil from being discharged through the sea-water system, and vice versa.

Grove Announces Changes

George E. Doty, formerly vice president-sales, Grove Valve and Regulator Co., Oakland, California, has been elevated to vice president and general sales manager in charge of all sales activities.

B. J. Hancock, formerly eastern regional sales manager, has been named vice president-sales and will be responsible for all field sales. E. C. (Early) Bird has been appointed a district sales manager in Houston and will handle sales of production valves in that region.

Ideco Appoints Managers

Three major managerial assignments have been announced by Geo. W. (Jack) Walton, president, Ideco Division of Dresser Industries, Inc.

J. C. Young has been transferred from London to Rome, as manager of Ideco Division, Dresser Italy. He will continue his duties as manager, Ideco Division of Dresser A.G.

W. L. (Bill) Farrow, appointed manager of Ideco Division, Dresser (Great Britain), Ltd., with offices in London, was formerly with Dresser International in Rio de Janeiro, Brazil.

Shannon L. Matheny, Jr. has been promoted to the post of New York export manager.

D. J. Cummins Takes Leave

D. J. Cummins, vice president-engineering, will take a leave of absence from Cummins Engine Co., Inc., after 40 years of service. He will continue to serve the company in a consulting capacity. Mr. Cummins has held many positions with Cummins including those of laboratory manager, manager-engineering, quality control manager, managing director-Cummins Engine Co., Ltd. in Shotts, Lanarkshire, Scotland, and vice president-engineering.

Kerr Heads Fluor Products

Robert W. Kerr has resigned as president and director of Fairbanks, Morse & Co., to become president of Fluor Products Co., a division of The Fluor Corp., Ltd. He was also elected vice president and a member of Fluor Corp.'s board of directors.

In his new position, Mr. Kerr will head Fluor Products' diversified operations, including the manufacture of industrial cooling towers, air conditioning towers, and glued-laminated roof structures.

R. W. Kerr

E. R. Koberg

BJ Names Koberg

E. R. Koberg, export sales manager has been made a vice president of Byron Jackson Tools, Inc. with headquarters in London, England. Ed Koberg previously has directed BJ Oil Tool export sales operations from the company's offices in New York City. At the same time, John Bonner was named export representative for Byron Jackson Tools, Inc. and will be responsible for BJ Oil Tool sales operations centering in the company's existing offices at 580 Fifth Avenue, New York, N. Y.

Bowen Itco Export Office

Bowen Itco, Inc. has announced a new location for their export sales office in New York City. The office, which is under the direction of Louis P. Siracusa, eastern division sales manager, will be located in the General Dynamics Building, 1 Rockefeller Plaza.

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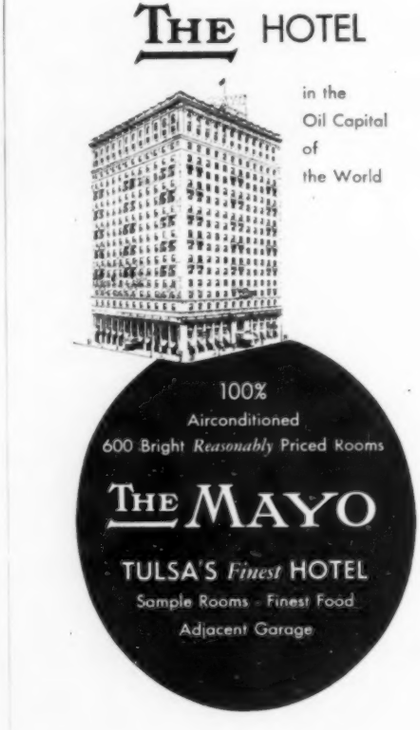

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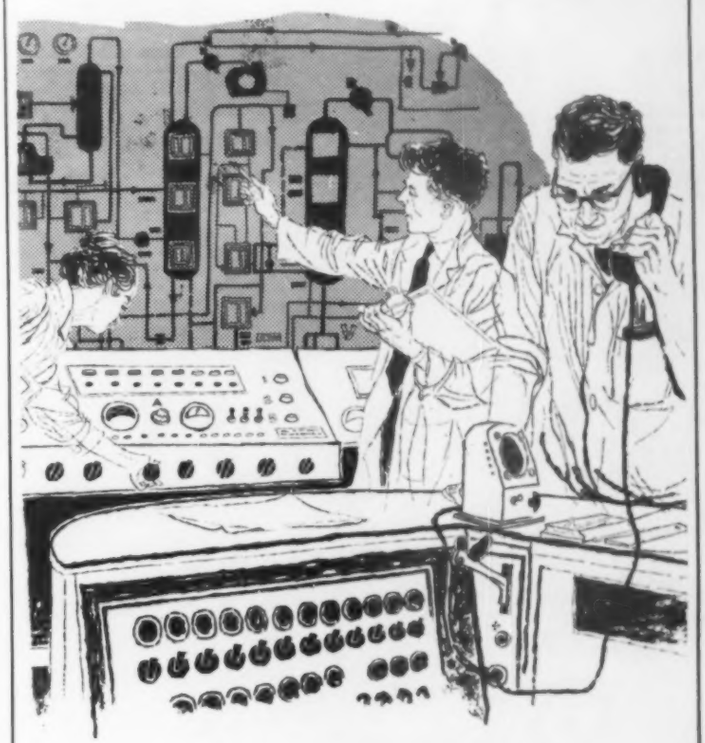

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ADVERTISERS' INDEX

(Advertising Agencies in Italics)

American Iron & Machine Works Co., Subsidiary American Machine & Foundry Co. Cover III
Lowe Runkle Company

American Machine & Foundry Co., American Iron & Machine Works Co. Div. Cover III
Lowe Runkle Company

Associated Electrical Industries Ltd. 113, 127
Technical & General Adv. Ltd.

Birkett, Billington & Newton Ltd. 126
S. C. Peacock Ltd.

British Ermeto Corporation Ltd. 129
A.T.A. Advertising Ltd.

The British Petroleum Co. Ltd. 77
S. H. Benson Ltd.

Burton Delingpole & Co. Ltd. 97
S. H. Wright & Co. Ltd.

Byron-Jackson Tools Inc. (A Subsidiary of Borg-Warner Corp.) 39
John Ramsey Company

California Texas Oil Company Ltd. 5
Gaynor & Ducas, Inc.

Camdrill International Inc. 114

Cameron Iron Works, Inc. 27
Boone & Cummings

Cape Asbestos Company Ltd. 110-111
Taylor Advertising Ltd.

Carrier International Ltd. 32
N. W. Ayer & Son, Inc.

Chiksan Company 79
The McCarty Company

Cities Service Oil Company 61
Ellington & Company, Inc.

Clark Bros. Co., One of the Dresser Industries 78
Persons Advertising, Inc.

Continental-Emsco Company, A Division of The Youngstown Sheet and Tube Co. 24-25
Rogers & Smith Advertising Agents, Inc.

Cummins Diesel International Ltd. 6-7
Gotham-Vladimir Advertising, Inc.

Daimler-Benz AG 63
Heumann Werbegesellschaft MBH

Davey, Paxman & Company Ltd. 122
Industrial Publicity Ltd.

Demag AG 16
Linder Presse Union GMBH

Dowell, Div. of Dow Chemical Co. Cover IV
Rives, Dyke & Company

English Electric Company Ltd. 23, 115
The Technical Advertising Service Ltd.

Ethyl Corporation 1
Reach, McClinton & Company, Inc.

Fibreglass Ltd. 123
Notley Advertising Ltd.

Foster Wheeler Corporation 72-73
Arndt, Preston, Chapin, Lamb & Keen, Inc.

Gardner-Denver Company 109
Buchen Advertising

General American Transportation Corp. 13
Edward H. Weiss & Company

Geograph Company 129
Lowe Runkle Company

Grove Valve & Regulator Company 91
L. C. Cole Company, Inc.

Gulf Oil Corporation 15
Ketchum, MacLeod & Grove, Inc.

Matthew Hall & Company Ltd. 31

Halliburton Company 40
Glenn Advertising, Inc.

Frederic R. Harris, Inc. 104

Herb J. Hawthorne, Inc. 118
Robinson-Gerrard-McGary, Inc.

Hewitt-Robins, Inc. 98
Fuller & Smith & Ross, Inc.

Hughes Tool Company 37-38
Foote, Cone & Belding

I.C.I. Heavy Organic Chemicals Div. 69, 117
Clifford Martin Ltd.

I.C.I. Billingham Div. 103
Clifford Martin Ltd.

M. W. Kellogg Company 75
Fuller & Smith & Ross, Inc.

LaFarge Aluminous Cement Co. Ltd. 95
Allardyce Palmer Ltd.

Owen P. Lake 129

London & Midland Steel Scaffolding Co. Ltd. 82
S. H. Wright & Co. Ltd.

The Lummus Company 2
G. M. Basford Company

Manning, Maxwell & Moore, Inc. 101
Fuller & Smith & Ross, Inc.

Mayo Hotel 128
Ferguson Miller Associates

McCullough Tool Company 29
Raymond O. Perry Advertising

Mid-Continent Supply Company 34-35
Magnussen Advertising Agency

Milwhite Mud Sales Company 18-19
Boone & Cummings

Mission Manufacturing Company 20
Rives, Dyke & Company

Newman Hender & Co. Ltd. 30
Adams Bros. & Shardlow Ltd.

Novacel Blanose 126
Synergie

The Ralph M. Parsons Company 33
Dozier Eastman & Company

Petroleum Information 36

Petrolite Corporation 99
Batz-Hodgson-Neuwoehner, Inc.

Procon Inc. 116
Tobias, O'Neil & Gallay, Inc.

The Pyrene Company Ltd. 28
Nelson Advertising Ltd.

Renold Chains Ltd. 124

Richardsons, Westgarth & Co. Ltd. 125
Notley Advertising Ltd.

Royal Netherlands Harbour Works Co. Ltd. 9

Schlumberger Overseas 57
Rives, Dyke & Company

Socony Mobil Oil Company 88-89
Compton Advertising, Inc.

Sydney Smith & Sons Ltd. 68
S. H. Wright & Company Ltd.

Standard Oil Company of New Jersey 21
McCann-Erickson, Inc.

Standard Vacuum Oil Company 65
McCann-Erickson Corp. (International)

J. Stone & Co. (Propellers) Ltd. 26

Stone & Webster Engineering Corp. 17
Harold Cabot & Company, Inc.

Technip 108

Texaco Inc. 11
Cunningham & Walsh, Inc.

TSA Transcontinental Airlines 87
Richard & Raymond Advertising

Truck Trailer Supply Company, Inc. 12
Paul F. Etrick & Associates

Friedrich Uhde GMBH 58

Universal Oil Products Company 83, 93
Tobias, O'Neil & Gallay, Inc.

Universal Oil Products Company Products Dept. 107
Tobias, O'Neil & Gallay, Inc.

Voisin Restaurant 128
Daniel & Charles, Inc.

Warren Petroleum Corporation Cover II
Chapman Company

Werkspoor N.V. 105
Mark Fawdry Ltd.

Westinghouse Electric International Co. 120-121
Gotham-Vladimir Advertising, Inc.

Woodfield Rochester Ltd. 119
KS Advertising Ltd.

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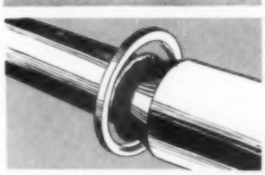
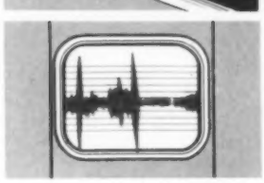


2. The "WEDDING BAND": a heat treating process used by AMERICAN IRON, which more than *doubles* the tensile-impact strength of the Flash Welded connection.



3. The REFLECTOSCOPE is a new electronic testing apparatus used by AMERICAN IRON for inspecting the weld zone for inclusions and defects. This assures you of *maximum performance* from your string of Flash Welded Tool Joints.

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